THE

ELECTRICAL REVIEW.

VOL. LXXXIII. AUGUST 16, 1918. No. 2,125.

ELECTRICAL REVIEW.

Vol. LXXXIII.] CONTENTS: August 16, 1918. [No. 2,125.

	Page
British Scientific Products	145
Wire Manufacturers and Merchants	146
Regenerative Electric Railways	147
An Effect of Subsidence on Electric Mains, by W. Fennell (*illus.*)	148
Import Trade of Ceylon	149
Mining Electrical Engineering, by C. Jones (*illus.*) (*continued*)	150
Water Power in the British Empire	151
Correspondence—	
The Future of Coal Using	152
Lightning Accident at Tonbridge	153
Trade Unions: Past, Present and Future	154
The Problem of Reconstruction	154
The British Scientific Products Exhibition	155
War Items	156
Business Notes	156
Notes	162
City Notes	162
Stocks and Shares	163
Market Quotations	164
The Position of the Electro-Technical Industry of the World during the War	165
Reviews	167
Foreign and Colonial Tariffs on Electrical Goods	168
New Patents Applied for, 1918	168
Abstracts of Published Specifications	168
Contractors' Column	Advertisement page xxii

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY

OFFICE:—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGENRAY, CENT., LONDON." Code, A B C
Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 392.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: Peter G. Tait, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: Peter G. Tait, 273, George Street; Gordon & Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

NOTICE TO READERS.

In view of the Order recently issued by the Paper Controller, readers are urged to place a definite order with their newsagents for regular supply of the ELECTRICAL REVIEW weekly. In the event of difficulty arising in so doing, a subscription rate order should be forwarded direct to these offices, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

BRITISH SCIENTIFIC PRODUCTS.

THE crisis of a devastating war would not, at first sight, appear to be an auspicious moment for the holding of an exhibition; but, as in other relations, everything depends upon the circumstances, and in this case the circumstances are unique and cogent in the extreme. We refer to the Exhibition of British Scientific Products which was opened on Monday last at King's College, London, and which has been organised by the British Science Guild to show what has been accomplished by British scientific industries during the past four years of war, and to impress upon the nation the fact that, if it chooses to encourage and develop the talent and ability which it possesses, it can face the future with perfect confidence. In spite of the numerous articles that have appeared in the technical and lay Press, there is no doubt that many members of the public do not yet realise that, spurred on by the national needs in the most threatening emergency that we have ever faced, and protected from destructive competition by the very fact that we are at war with our competitors, our technical and scientific workers have accomplished *miracles*. They have utterly exploded the popular idea, so carefully fostered by our enemies, that scientific production was a German monopoly; and not content with equalling the pre-war German products, they have in numerous instances far excelled them. Consider what this means.

The scientific *personnel* of British manufacturing industry when war broke out was far below what it should have been even in normal times, and still more inadequate to cope with the stress of war conditions; it was further depleted by the enlistment of many of its brightest members, who, alas! will never resume their labours in this sphere; labour was scarce, and in some industries skilled labour was absolutely non-existent in this country; materials and machinery were lacking; technical processes were unknown and had to be worked out afresh by patient but "intensive" research. Are we not justified in claiming that, in these extremely arduous conditions, which might well break the hearts of lesser men, our manufacturers and their technical staffs and workpeople, under the guidance of our scientific experts—who alone could supply the keys to the secrets which had to be unlocked—achieved the impossible, and, therefore, accomplished miracles?

But what have they done? may be asked by the reader whose own endeavours to advance the national cause have restricted the range of his reading and observation. The British Scientific Products Exhibition is intended to supply the answer; there it will be seen that apparatus and materials of which the supply was formerly monopolised by our enemies, are now made by British hands; that processes which the Germans took long years to develop have been equalled and surpassed by us in as many months; that as we have done without the German supplies for years, so we can dispense with them for ever. We cannot here attempt to schedule the items exhibited; there are some 200 exhibitors, few of whom are unable to show products developed during the war to replace former imports. Optical glass, important drugs, potash, hard porcelain, tungsten, magnetos, certain insulating materials, lamp bulbs, glass wool, thermit, searchlight and furnace carbons, dry cells, electromedical apparatus, photographic materials, dopes for aeroplanes, laboratory glassware, miners' lamp-glasses, synthetic dyes, refractory materials—all these are well-known products which formerly were more or less wholly German monopolies, but are now manufactured here in large quantity and of first-class quality. But these are only the items that may be shown to the public now; there

are many others of which, in the national interest, it is not expedient to speak at present. Even so, there is abundance of evidence to prove beyond all doubt that when the British are put to the test, they can equal and outclass their German rivals, even when heavily handicapped.

Once more let us point out that certain conditions were necessary, to enable our industrialists and scientists to demonstrate their mettle: the compelling incentive of a national emergency, the support of the Government, and protection from the cut-throat methods of German competition. What the last-named means may well be exemplified by the case of photographic paper. At least one British firm, before the war, had developed the manufacture of this material to the commercial stage, and endeavoured to secure a market; retailers were ready and willing to take up the sale of the British product, but the German manufacturers held the field, and those retailers were compelled to carry on the negotiations in the strictest secrecy, for if the Continental combine controlling the trade became aware of the attempt to market British paper, it would immediately boycott the firms concerned and ruin them. It will be seen that the ability to bring about such a result was a trump card in German hands, and this explains why many commodities which could perfectly well have been made in this country, and which manufacturers were anxious to make, could not possibly be put on the market—truly a deplorable state of things, which must never again be permitted to exist. It is obvious also that not only individual, but also co-operative, action was powerless in the face of such an obstacle, for the consumer would insist on having the brands to which he was accustomed, and the German threat of cutting off the supplies compelled distributors to toe the line.

The war has changed all that; the consumer has had to accept the British product, and finds that it is as good as the German. The charm is broken. But even as, before the war, the situation was insoluble without the intervention of the State, which but for the war would never have been granted, so after the war the aid of the Government will be indispensable to prevent the flooding of our markets with cheap German products and the return of the old conditions. There is no possible alternative in the face of the German system.

The catalogue of the British Scientific Products Exhibition contains 100 pages of articles on recent developments, by experts in a score of industries, articles which alone would constitute a work of absorbing interest; and again and again in those essays the same note is struck—in quality we can hold our own; our scientific resources, though undeveloped, are unexcelled; but all will prove of no avail against German State-aided methods of competition unless our manufacturers are protected from their ravages.

Another feature of these articles is the hopeful tone with which they are pervaded—the assurance that in the future, as during the war, the British Empire can, and will, be self-supporting in all essential industries. But this is subject to the proviso that manufacture is carried on under scientific conditions, and supported by the State. The inevitable corollary is that training in science must in future be developed on a vastly greater scale than heretofore. As Prof. Gregory, chairman of the Exhibition Organising Committee, pointed out in an address to the technical Press on Monday, in the United States there are 40,000 students under training as technical experts; in Germany, 17,000; in the United Kingdom, barely 5,000. The funds devoted to the purpose by the respective States vary in a similar ratio; and in the past the prospects offered by our manufacturers to their technical experts have been too poor to attract men into such careers. The necessity for radical reform is as imperative as it is obvious. The root of the trouble is our government by men exclusively trained in a classical atmosphere and utterly ignorant—as the war has proved to demonstration—of the most elementary facts of science, while their whole environment has instilled into them contempt for trade and industry—a heritage from feudal times, fostered by our ancient Universities, which has cost us untold wealth in blood and treasure in this war. Had we been governed by men of affairs instead of politicians, there would have been no war.

Wire Manufacturers and Merchants.

The attitude in the past of British wire manufacturers towards merchants in the trade, while containing nothing hostile in its nature, according to views several times expressed by merchants, has not been encouraging from the point of view of the general welfare of the trade. The opinion was expressed some years ago by a director of an important firm of copper wire manufacturers that there was very little need for merchants in the trade, on the grounds that manufacturers seldom found it necessary to go in search of orders, and that the trade was confined almost exclusively to one industry, the electrical.

At the time this view was expressed, Germany was exporting into this country copper wire, strip, &c., to the value of over £300,000 per annum, which, at the present basis price of copper, would be equivalent to about £800,000 per annum. America was also sending large quantities, and preparing greatly to increase the total. The fact would, therefore, appear to be that a huge amount of merchanting must have been going on in this country before the war, but the *beneficiaries*, instead of being British, were mostly German and American. If it is true, as has been stated, that it was often far easier to sell German wire than British in this country before the war, the cause was probably due to the fact that German wire was the more freely obtainable and sold under fewer restrictions. If, in view of these facts, the British manufacturer had little occasion to go in search of customers, which may be taken to imply that he had as much trade as he could conveniently cope with, either there was need for a considerable expansion in the manufacturing section, or the distributing organisation was not as comprehensive as it might have been.

It will doubtless be recalled, however, that there were frequent occasions in the past when British wire manufacturers, particularly in the fine-wire section, experienced slack periods, some of them of protracted duration. In the full year before the war, 1913, when the German manufacturers exported more fine wire into this country than ever before, there was in two at least of the largest British firms a distinct slackness in this section. Yet these two firms could probably have been maintained on full time had they offered inducements to merchants, or had they even sent out representatives to obtain the orders that were directed elsewhere. It will, perhaps, be admissible that as regards these two cases, which control about a quarter of the country's influence in the copper wire manufacturing industry, the observation that there was little need for merchants was not entirely applicable.

After the war, the demands upon British wire manufacturers will probably for some time greatly exceed their capacity for output, and their undivided attention will be most advantageously employed in the production of manufactured goods rather than in distribution. A few reliable and experienced merchants attached to a firm might prove of great service, especially as regards the handling of the multiplicity of small orders, as also in the shipping section. We have reason to believe that several propositions as regards merchanting have been submitted to American firms by Englishmen, highly experienced in the wire and electrical industries, who are uncertain of the future attitude of the British firms. This also is without taking into consideration the possibility of German wire finding its way through neutral sources into this country, supposing that German goods be placed under an embargo.

The British wire manufacturers have, however, displayed on many past occasions a high capacity for adapting themselves to improved methods both of manufacture and distribution; and this capacity, supported with the lessons the war has taught this country, will doubtless prove equal to whatever demands are made upon it. At the same time, it has to be carefully borne in mind that present conditions demand a more accelerated decision than those of the past; and to this end a still closer co-operation of interests in the trade generally will probably be found quickly to justify the enterprise.

REGENERATIVE ELECTRIC RAILWAYS.

[COMMUNICATED.]

At the present time, when much discussion is taking place relative to possible methods of saving coal, the question of introducing regenerative systems on electric railways presents itself. Much less is heard about regenerative electric traction in these days than in the past. So far as electric tramways are concerned, the idea of returning energy to the line has not met with the widespread favour that some expected; but on certain electric railways, notably on the Continent and in America, the regenerative principle is making headway. On railways the system shows up to better advantage, owing largely to the greater amount of kinetic energy available, and in a smaller measure to the higher efficiency of the equipment. The system most suitable for regeneration is, of course, the three-phase system as employed mainly in Italy. A three-phase motor of ordinary design will readily act as a generator if the speed of the rotor exceeds that of the revolving field, and on railways possessing steep gradients three-phase regenerative equipments have, as is well known, given excellent results. When regenerative control is used in connection with locomotives on mountain grade sections, the saving in energy is not by any means the only advantage secured. On such railways more accidents occur when trains are running down gradients than when they are ascending gradients.

Accidents may arise as the result of overheated brake shoes and wheels. For the operation of heavy trains on steep gradients the regenerative principle offers marked advantage from the point of view of safety because it provides a better means of holding trains than is obtainable with any air brake system. The motors, however, always depend upon the generating station for their exciting current, irrespective of whether they are acting as motors or asynchronous generators; hence, if the supply fails, the electric braking system no longer remains active, and mechanical brakes must be brought into action. Another point to be noted is that induction motors will only regenerate on the level by bringing into action multiple-speed control, for these motors will not act as generators unless the speed of the rotor exceeds that of the rotating field. With the two-speed cascade control system, for instance, it is only possible to make the motors regenerate on the level by connecting the motors in cascade, and the braking action ceases as soon as the synchronous speed of the combination is reached. The control of the speed whilst the motors are regenerating can only be effected by inserting resistance in the rotor circuit, which naturally impairs the efficiency, but rheostatic losses can be minimised by employing a four-speed equipment.

When trains are running down gradients the economy is well marked, for there is not, as a rule, any necessity to insert resistance in the rotor circuit, and the energy returned to the line is equivalent to the work done by gravity less the usual electrical and mechanical losses. For a given frequency light trains will, under these conditions, descend gradients at practically the same speed as heavy trains, although, at the sacrifice of efficiency, the speed can be varied at will by introducing additional resistance into the rotor circuit. A difficulty sometimes met with in connection with regenerative electric traction systems is that the energy returned to the line occasionally exceeds the demand on other parts of the system, when the surplus energy must be absorbed in water resistances. But in the case of stations that deal with other loads, in addition to traction load, this trouble does not, as a rule, present itself.

In this country, where the direct-current system predominates, no attempt has been made to apply the regenerative principle to railways; but, needless to say, this is not because the direct-current system does not lend itself to regeneration. It is true that three-phase motors will regenerate more readily, but against this must be set the fact that the three-phase system demands two overhead wires. The overhead equipment is, therefore, more expensive to erect and maintain as compared with systems involving only one overhead conductor, and there is a greater risk of breakdown.

With the direct-current system the main difficulties associated with regeneration arise in connection with the motors, but these difficulties are not by any means insurmountable. The fact that the locomotives constructed for the Milwaukee and St. Paul Railroad are designed for regeneration proves, if proof be needed, that the regenerative system is applicable to direct-current railways. There may be possibilities for the regenerative system on interurban and suburban direct-current lines where the runs are short and stops are frequent.

It has been estimated that the power used for propelling trains in some cases is less than that used in grinding up brake-shoes. Under such conditions it seems that a simple and effective regenerative system would be distinctly advantageous. Among other things that have to be taken into account, however, is the fact that the motors would be somewhat larger and heavier than present machines. On lines such as those under consideration, the motors, under existing conditions, only carry current intermittently, whereas electric braking might involve their carrying current nearly all the time. Furthermore, regenerative equipments are necessarily more complicated and more expensive than standard direct-current equipments. So far as the size and weight of the motors are concerned, the difficulties might be considerably minimised by the use of forced ventilation. But as the standard direct-current traction motor is of the series type, it cannot be used directly as a traction generator. Either a shunt winding must be provided in addition to the series winding, or the latter must be separately excited at low potential. A system of regenerative control, differing from the ordinary direct-current systems as applied to electric tramcars, has been tested on the Metropolitan Railway of Paris, and it has been found that the energy consumption is at least 20 per cent. lower than that of a standard equipment. The system, however, involves the use of a combined booster and exciter set, the booster being used for starting and speed regulation as well as for boosting up the generated voltage during the regenerative period. Rheostats are, therefore, eliminated, and an efficient control system is secured. The booster is permanently connected in series with the traction motors, and the exciter, which is directly coupled to the booster, is made to excite the driving motors when it is desired to cause them to return energy to the line. The boosting and exciting set is, of course, an additional unit not met with on trains working under ordinary conditions, and the set naturally requires energy to drive it. So far as general operation is concerned, the system appears to be quite satisfactory, but opinions may differ as to whether this is the best and most efficient method of grappling with the problem.

On single-phase railways the regenerative principle cannot be adopted nearly so easily as on three-phase railways, or even on direct-current railways. Many experiments have been carried out with regenerative single-phase locomotives, especially on the Continent. With series compensated motors there is no difficulty in obtaining an electric braking effect. If a resistance be connected across the terminals of a series single-phase motor, the machine will act as a series-wound generator in the same way as an ordinary tramcar motor. This will, of course, give a braking effect, but when it comes to returning energy to the line, matters become rather more complicated. If a single-phase series motor be connected to the secondary of the transformer it will also act as a direct-current generator, and the current is limited only by the ohmic resistance of the windings. Evidently, then, it is necessary, in order to make a single-phase motor generate alternating current, to excite it separately. It is necessary, moreover, to pay due attention to the phase of the regenerated current. Nothing is to be gained by sending wattless current into the line, and it is in this connection that many single-phase regenerative equipments have proved unsatisfactory. Among other single-phase lines on which regeneration has been called for are the electrified lines of the Midi Railway in France. On the experimental line from Villefranche to Ille the motors of the experimental locomotives had to be capable of sending energy back into the overhead system. The firms that submitted locomotives did not all tackle the problem in the same way, and in some

cases the results were not altogether satisfactory. One firm using series compensated motors first adopted the plan of exciting one motor from the armature of the other, the motor so excited returning energy to the line. But afterwards this plan was abandoned, and, instead of returning energy to the line, it was dissipated in a resistance fitted to the locomotive. This scheme, as already pointed out, is quite satisfactory as far as electric braking is concerned, but it obviously does not lead to economy at the generating station. During the trials it was found possible to brake a 100-ton train on a 1·7 per cent. gradient, and to regulate the speed between 62 and 10 km. (38 to 6 miles) per hour. The most interesting and most satisfactory regenerative scheme was that employed on the locomotive built by the Ateliers de Constructions Electriques du Nord et L'Est, although, unfortunately, the equipment is a little complicated. Current for exciting the motors during the regenerative period cannot be taken directly from the main transformer, because in this case the energy sent back into the line would have a considerable phase difference with respect to the supply pressure. It is necessary, in order to obtain the desired results, to excite the motors from a circuit in which the voltage has a phase difference of 90° with respect to the supply voltage, and under these conditions the pressure at the terminals of the motors, at no load, will be in phase with the line pressure. When the motors begin to regenerate, however, the armature current will not be in phase with the armature E.M.F., and, in order to maintain the proper phase relation, the phase of the exciting current should alter with the regenerated load. Given these conditions, the regenerated current can be regulated at will by changing the transformer tappings with the aid of contactors, or with an induction regulator in the secondary circuit. In the case of the 1,500-H.P. locomotive under consideration the voltage is controlled entirely by induction regulators which are incorporated in the transformers. The voltage during the starting period is governed by these regulators, which also serve for controlling the energy returned to the line during the regenerative period. Transformer tappings and contactors are, therefore, unnecessary. During the regenerative period the main driving motors are excited by connecting the field windings to a special winding on the auxiliary motors which drive the air compressors and blowers whilst the armature and compensating windings of the main motors remain in series as under normal running conditions, and are connected to the main transformers through the induction regulators. The special windings on the stators of the compressor motors, which excite the main windings on the driving motors during regeneration, are displaced 90° with respect to the main windings of the compressor motors; hence at no load the voltage generated by the main motors has the correct phase relation for returning energy to the line. Current can, therefore, be drawn from the driving motors whilst the locomotive is descending a gradient or whilst being brought to a standstill by making the induction regulator voltage assist the regenerated pressure. But in order that the regenerated current should maintain its proper phase relation with respect to the line pressure, the phase of the exciting current must alter with the amount of regenerated load. The phase of the exciting current is changed by a "compensating" transformer and a series transformer, the primary of the latter being in series with the main secondary circuit through which the main current passes. The secondary of this series transformer is in series with the primary of the compensating transformer, the compressor motor, and main transformer, whilst the secondary of the compensating transformer is shunted across the special exciting winding on the compressor motor which excites the main driving motor.

There is little doubt, however, that where regenerative braking is required the so-called split-phase system is much better than the plain single-phase system. It is well known that with this split-phase system, which has been adopted on a section of the Norfolk and Western Railroad in America, the single-phase current collected from the overhead wire is converted into three-phase current in phase converters, and afterwards supplied to three-phase induction motors which drive the locomotives. In practice the phase converters resemble induction motors with two stator windings displaced by 90°. One winding is connected across the secondary of the main transformer, the ends of which form two of the leads belonging to the three-phase circuit which supplies current to the three-phase driving motors. The other winding of the phase converter has one end connected to some intermediate point on the main transformer, the opposite end of this winding forming the third wire of the three-phase circuit. With this simple arrangement the single-phase current collected from the overhead wire is converted into polyphase current, and all the advantages of three-phase induction motors for driving purposes are obtained. In order to secure a good power factor, however, the rotors of the phase converters are provided with an exciting winding in addition to a squirrel-cage winding, and this exciting winding is fed with direct current from a D.C. exciter.

An equipment of this kind is reversible—that is to say, when the locomotives are running down gradients the three-phase induction motors will act as asynchronous generators in the ordinary way, and will feed three-phase current back into the phase converters, which change it into single-phase current, which is fed into the line. On the Norfolk and Western Railroad the regenerative properties of the split-phase locomotives have proved highly beneficial, and there appears to be no doubt whatever that when regeneration is required on single-phase systems the use of phase converters on locomotives, at any rate, is to be recommended, quite apart from the advantages which arise from the use of three-phase driving motors.

AN EFFECT OF SUBSIDENCE ON ELECTRIC MAINS.

BY W. FENNELL, M.I.E.E.

BRINE pumping at Northwich not only supplies an article of universal consumption on which several industries depend, but also furnishes a series of engineering problems. There are two beds of rock salt underlying the town—each about 100 ft. thick. The first is met with at a depth of about 100 ft., and a bed of marl about 30 ft. in depth separates the two salt beds. Brine is formed by the action of fresh water which reaches the upper salt bed through the alluvial soil which overlies it, and as the brine runs towards the pumps the salt is eroded in an uneven manner. The soft upper soil, of course, easily follows the uneven top surface of the salt; local subsidences result, and many of these are in the centre of the town. There is a Compensation Board provided with funds to compensate owners of buildings affected, but, unfortunately, its benevolences do not as yet extend to the owners of gas and electricity undertakings.

Visitors to Northwich have recently been able to see an interesting example of the result of a subsidence in one of the main streets of the town. This street runs parallel to the River Weaver. During the last few years there has been a subsidence of about 8 ft. in the centre of a stretch about 100 yards long, so there is an incline of about 1 in 30 each way towards the middle. Buildings were, of course, thrown out of the vertical. Sewers, gas and water mains have been fractured, and electric cables have been strained to such an extent that they have pulled the joint-box fittings into contact with each other, or the cable ends have drawn out of the terminal sockets. The subsided surface of the road was but a little higher than that of the adjacent river, and owing to the porous nature of the soil, premises became unhealthy, and all mains, including sewers, were water-logged.

A partial restoration of the levels, amounting to a rise of 3 ft. in the centre of the depression, is now in full swing, so that conditions will, it is hoped, be tolerable until after the war, when another lift is contemplated. Raising the surface involves also the corresponding lifting of buildings and their surroundings, and also of all mains and services; otherwise the latter would in a few years be completely

ruined by continued extension, even if they were not practically lost in the depth of made-up ground.

It may be imagined that very special precautions have to be taken in the choice of a cable system, and in the layout to cope with these conditions. Fortunately, experience has accumulated in the 20 years of public electricity supply in the town, during which many of the weak spots have been removed.

In raising electric cables, every care has to be taken to provide for further subsidence; the cable must be relaid with slack provided in such a manner that it can again straighten out in following the road surface in its downward course.

There are at times secondary effects of subsidence the reverse of what one would at first sight expect. The illustration shows one of these curious cases. Subsidence has been made up on previous occasions with boiler ashes, and in the present case there has been a movement not merely vertically downwards but in an inclined direction due to the slope and to the loose nature of the ground. The horizontal component of this motion was shown by the lifting

Corkscrew effect on Cable due to Subsidence of Ground.

of the pavement at the middle of the dip, and on excavation some of the cable slack was found to have been carried with the ground down both slopes to the lowest point. The surplus cable had to go somewhere, so it has formed a corkscrew! The cable is ·15 sq. in. area triple-concentric, lead-covered, and armoured, and was made by the B.I. and Helsby Cables, Ltd. The diameter is 1½ in. over the lead and about 2¼ in. over all. The radius of the curve formed is 4½ to 5 in. So far as can be ascertained, the cable is uninjured. If there had been a joint box at or near the spot it is probable, unless precautions had been taken in laying, that the fittings would have been forced out of place, and a short-circuit formed. It is not proposed to straighten the cable any more than is necessary to work some of the slack back up the inclines. There is a somewhat similar kink on the distributor on the opposite side of the road, so that the result shown is a characteristic one, caused by the conditions, and is not due to accidental circumstances.

The illustration shows incidentally the method of building and of raising houses in the unsettled areas. A special design of building has been evolved to meet the conditions. A very strong underframe carries timber uprights; the brick walls are 4½ in. thick, wedged in between the timbers. The whole structure is strongly braced to resist racking due to uneven subsidence, or to the treatment it receives during lifting operations. The underframe is supported on the brick walls, which are built up to 6 in., or even 3 ft. or more above ground level, to allow of the road being raised a moderate amount without lifting the building. The top course of bricks is specially perforated to allow of free access of air to the timber underframe. Ceilings and internal wall linings are usually either match-lined, or are of uralite or other sheeting. It is interesting to note that not only do the local building by-laws allow this light construction with walls thinner than the standard, but the conditions imposed by the Compensation Board practically prohibit the erection of new buildings in the subsiding areas in any other manner. One at first thinks the buildings must be very ancient, but the designers of even the most recent are by circumstances compelled to follow the old timbered style of architecture which is the pride of our ancient country towns.

When the buildings are lifted plentiful supplies of screw jacks and packing are provided by the Compensation Board. The supporting wall is cut away as necessary, and is used as the jacking base. The building shown in the illustration has just been lifted 3 ft.—"Business as usual" being the motto of this china shop. The rough steps will, of course, be removed when the pavement is re-laid at its new level. The final packing is in place ready for the new brickwork which will be carried up from the old foundation.

IMPORT TRADE OF CEYLON.

The following figures, showing the value of the imports of electrical and allied material into Ceylon during 1916, are extracted from recently-issued official statistics. The values for the previous year are given for purposes of comparison, and notes added of any increases or decreases:—

	1915. Rupees.	1916. Rupees.	Inc. or dec. Rupees.
Manufactures of copper.—			
From United Kingdom ...	45,000	19,000	− 26,000
,, India	20,000	26,000	+ 6,000
,, Other countries ...	2,000	7,000*	+ 5,000
Total	67,000	52,000	− 15,000
* Japan.			
Electrical materials.—			
From United Kingdom ...	118,000	253,000	+ 135,000
,, India	—	14,000	+ 14,000
,, Other countries ...	8,000	16,000*	+ 8,000
Total	126,000	283,000	+ 157,000
* United States Rs. 8,000.			
Scientific instruments.—			
From United Kingdom ...	16,000	20,000	+ 4,000
,, India	3,000	7,000	+ 4,000
Total	19,000	27,000	+ 8,000
Lamps.—			
From United Kingdom ...	62,000	123,000	+ 61,000
,, Japan	11,000	31,000	+ 20,000
,, Other countries ...	34,000	66,000*	+ 32,000
Total	107,000	220,000	+ 113,000
* United States Rs. 32,000.			
Machinery, foundry and workshop.—			
From United Kingdom ...	554,000	708,000	+ 154,000
,, United States ...	5,000	22,000	+ 17,000
,, Other countries ...	2,000	2,000	—
Total	561,000	732,000	+ 171,000
Other machinery, dutiable, not including tea, textile, and oil-making.—			
From United Kingdom ...	13,000	43,000	+ 30,000
,, Other countries ...	3,000	11,000*	+ 8,000
Total	16,000	54,000	+ 38,000
* United States Rs. 9,000.			
Ditto, free.—			
From United Kingdom ...	625,000	828,000	+ 203,000
,, Germany	8,000	—	− 8,000
,, United States ...	14,000	87,000	+ 73,000
,, Other countries ...	183,000	23,000	− 160,000
Total	830,000	938,000	+ 108,000
Telephone materials.—			
From United Kingdom ...	11,000	11,000	—
,, Other countries ...	—	8,000*	+ 8,000
Total	11,000	19,000	+ 8,000
* United States Rs. 5,000.			

N.B.—15 Rupees = £1.

D

MINING ELECTRICAL ENGINEERING.*

By CHRIS. JONES, M.I.E.E.

(*Continued from p.* 127.)

It is necessary to consider the installing of reactance on systems of present-day magnitude in order to limit the mechanical stress imposed on every winding in the main circuit by the current flowing through a fault between phases, and this is best secured by inserting the reactance at a point where all such fault currents must pass, that is, at the generator terminals.

The types of cables commonly used are vulcanised rubber, paper, sheathed with lead or vulcanised bitumen, and vulcanised bitumen throughout. Vulcanised rubber is rarely considered for shaft and roadway cables on account of its high price. The writer has used this type extensively for interconnections between motors, switch and control gear, &c. In some cases a sheathing of vulcanised bitumen has been applied over the rubber insulation, owing to the deleterious chemical action in positions where the cables were installed. This is also to be highly recommended over the armour of other type of cables in special cases, as met with in some mines. Paper cable has been extensively used in mines for shaft and roadways with success. For overhead suspension the writer has used this type, but without the lead sheath. It is claimed that a paper cable has great advantages over bitumen in that it possesses greater dielectric strength. This is scarcely relevant, since, although the dielectric strength of paper is higher than that of bitumen, the latter is quite suitable for all usual colliery working pressures. Ths writer has used vulcanised bitumen cables on E.H.T. successfully. It is also claimed that paper cable can be worked at higher temperature, and therefore at a greater current density. Paper cables can certainly be worked at a higher temperature than vulcanised bitumen. This, however, does not necessarily imply that a greater current density is possible, since the construction of the latter type provides better means of dissipating heat generated in the cable by C^2R losses, owing to the increased thickness of dielectric. The overall diameter, and consequently the area of radiating surface, of a vulcanised bitumen cable is considerably greater than that of a paper cable with a similar size of conductor. In practice, the question of temperature limitations is rarely a deciding factor, as the sectional area of the conductors is usually determined by the permissible loss of volts in transmission, which keeps the current density well within these limits. For portable machines, such as coal cutters, &c., the cab-tire sheath cable excels any other type in all respects, but the writer thinks that cable makers would greatly add to the safety of the working of portable apparatus if an earth chield was made to surround the cores of such cables. The writer was called to inspect and report upon an electrical installation, and when visiting a portable machine the size of the trailing cable immediately caused doubt as to the earth core being that called for in the H.O. Rules. Upon thorough investigation of cable ends these doubts were confirmed, the earth core being about 15 per cent. of the section called for in the rules. The cable in question was supplied through agents who supplied the machine, and who evidently were not

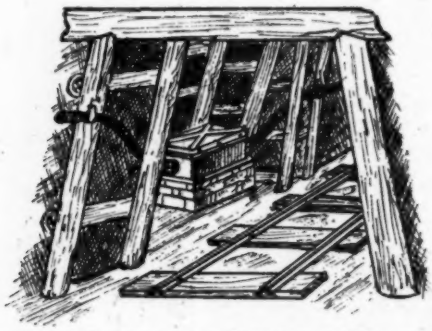


Fig. 5.—Cables Leading in to Joint-box at Back of Timers.

aware of the clause regarding minimum size of earth conductors, viz., 0.022, although the specification read that all was in conformity with the H.O. Rules. Such cases as these are liable to get colliery owners and officials into unpleasant positions.

Cable manufacture is of a very high standard (by reputable makers), and there is no cause to complain. The writer has a large area underground and overhead covered by high- and low-tension, and can say that for the last six years not a single fault has developed due to faulty manufacture. Some makers seem to think that to deliver cables with space of ¼ in. and ⅛ in. between armour wires is not detrimental to the cable; but it is certainly so, as it means that when the jute serving is cut off, which is a common occurence due to falls of roof, the layer of armour becomes quite loose. It also makes it easier for sharp tools making contacts with cores to make it alive, and is liable to allow moisture to get in and corrode the armour wires in course of time, as some pit waters attack cables badly. Cables may be installed underground, suspended on road side, at centre of road, and about 6 in. from the floor. The author does not recommend the burying of cables. It is sometimes difficult to fix the cables in order to meet the requirements of the Coal Mines Act and Electrical Rules, so that the above alternative methods have to be adopted. Cables require the greatest care when installed. A common occurrence is to find at joint-boxes and gate-end switches the cables leading in front of the timber instead of at the back, as shown in fig. 5, which is the safest method in view of tubs being derailed. Another matter is the short bends given to cables. Fig. 6 shows the class of bend which cables should receive when leading in and out of switchgear, but, of course, underground conditions do not always allow of the necessary

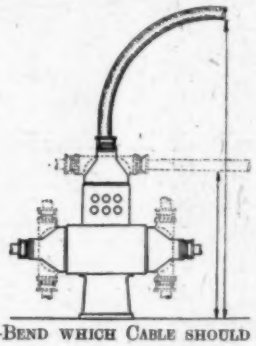


Fig. 6.—Bend which Cable should receive.

height for such bends. It would be advisable to refer some switch designers to figs. 6 and 7, which afford alternative methods when height is not obtainable. It would appear that, owing to recent legislation and past experience of mining electrical plants, the last word has been said *re* cable installation and wiring; but this is not so, as recent electrified collieries have resorted to the use of very low grade insulated cables in steam piping on 500-volt circuits where a great deal of vibration takes place, such as on screens, &c. In another instance, on surface and underground, slip conduit is used on a 500-volt system. This latter practice is highly dangerous. Another instance may be given of single conductor armoured cables being used underground on a three-phase sectional system.

It is essential to give serious consideration to area of feeders when coal-cutting developments are in progress in view of the advancing of coal faces, and the tendency is to overlook the voltage drop question, which is the cause of a great deal of motor trouble. There is also the question of the conductivity of the armour of high-tension systems when transformers are used. This should be equal to 50 per cent. of low-tension feeder, unless an efficient earth plate can be placed in-bye, which is not often obtainable, or unless an earth core forming an integral part of the cable is used.

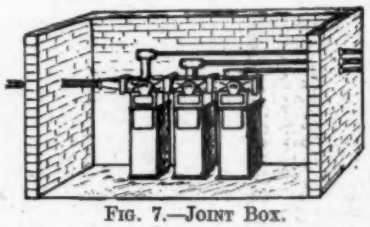


Fig. 7.—Joint Box.

which is the best. The installation of duplicate cables in upcast and downcast shafts is worthy of consideration in view of accidents, so as to enable the most important parts of the colliery to be worked, such as fans and pumps. The recording of areas and length of individual cables, is essential in order that such may be available for fault-finding purposes. The cables should be periodically painted to preserve the jute serving. When inquiring for cables the fullest information should be given to the makers in order that they may offer the best cable for the conditions. The question of overheating of cables is often overlooked.

The ordering of cables should not be left to stores clerks, &c., who simply look at cable makers' lists for a cable to carry so many amperes. Two or three recent cases may be cited where cables have been ordered in this manner. The section that will carry the number of amperes required is purchased. This policy has been the cause of a great many electrical breakdowns. The question of the testing of trailing cables deserves special attention. The greatest care

* *Proceedings*, South Wales Institute of Engineers. Vol. 34, No. 2. Abstract.

should be taken to maintain the conductivity of the earth conductor equal to that required by rules. The practice of testing such cables with galvanometer is useless, as, for instance, an earth core of 91/0.018 complies with the requirements, but even one strand missing will make such uncompliable, and even if there is only one strand continuous a deflection could be obtained. The best practice is to test for ohmic resistance, or pass full load current through earth core at least once per week, which is the author's practice; also, double working pressure should be applied to such cables weekly, and a continuity test applied with low resistance bell and battery daily is useful. Several accidents have occurred in the past due to defective earth conductors in trailing cables, and it is imperative, therefore, that the strictest attention be given to such cables. The use of armoured cables of single and multi-core types is to be highly recommended for signalling, telephoning, and lighting circuits underground, and for interconnecting motors and switchgear. The use of bare lines is troublesome.

Transformers will be more called for in future than generating plants. When considering the type of transformer, it is often overlooked that for large size the forced-cooled type is cheaper than oil-immersed self-cooled type, and that the oil-immersed self-cooled type is cheaper than the natural-air-cooled type. Another point which appears a very elementary one is the calling of, say, 200-KW. transformer without mentioning the power factor when the K.V.A. output of 200 is really meant. The overload capacity is important. The question of the advisability of having any overload capacity, and, if so, the value, should be carefully considered, as this materially alters the price of the transformer. When purchasing transformers, due consideration must be given to capitalising losses. The losses of competitive offers should be carefully studied and capitalised on the basis of the cost of power, and in many cases it is surprising how soon the better transformer pays for itself, due to its lower losses. The overload capacity of competitive offers should be carefully studied, unless they are of common basis. The question of single- and three-phase is worth consideration. It is essential that the transformer be of sound mechanical construction.

When considering oil-immersed and air-cooled transformers, it must be borne in mind that the oil-immersed type has a much longer life, as oil acts as a preservative on the insulating material. When considering offers of transformers with a number of tappings, care should be taken to see that the K.V.A. output is the same for the various ratios. This is apt to be overlooked. It is essential that good quality oil should be supplied, even if it costs a little more, as it would easily pay for itself. The writer has found the Ferranti float device a very efficient method of preventing sludging of the oil. It is quite common to see tranformers supplied with no provision made for finding temperature, and, after all, the life of a transformer depends upon this factor. Cases are known to the writer where low load conditions give greater heat than full load.

(To be concluded.)

WATER-POWER IN THE BRITISH EMPIRE.

THE preliminary report of the Water-power Committee of the Conjoint Board of Scientific Societies has just been issued. This committee was appointed "to report on what is at present being done to ascertain the amount and distribution of water power in the British Empire," and with this in view the Committee has endeavoured to collect all available relevant information. Sir Dugald Clerk was chairman.

The main conclusions to be drawn from the evidence available to the Committee are:—

That the potential water-power of the Empire amounts in the aggregate to at least 50 to 70 million horse-power, much of which is capable of immediate economic development; that except in Canada and New Zealand, and to a less extent in New South Wales and Tasmania, no systematic attempt has as yet been made by any Government department to ascertain the true possibilities of the hydraulic resources of its territories, or to collect the relevant data; that the development of the Empire's natural resources is inseparably connected with that of its water-powers; and that the development of such enormous possibilities should not be left to chance, but should be carried out under the guidance of some competent authority.

In view of these conclusions the Committee submits the following recommendations:—

1. That the British Government bring before the notice of the Indian Government, of the various Dominion Governments and of the Governing Bodies of the Crown Colonies, the necessity, for a close, systematic investigation of all reasonably promising water-powers, and of their economic possibilities.

2. That the British Government take steps to ascertain whether the Governments concerned are prepared to undertake this work.

3. That where such an inquiry is beyond the powers of any governing body, the British or Imperial Government place the work under the direct control of an "Imperial Water Power Board" or "Conservation Commission."

4. That the Government take steps to initiate the formation of such an "Imperal Water Power Board" or "Imperial Conservation Commission," to include a representative from each of the Dominions and Dependencies.

5. That this board act in an advisory capacity.

6. That since it is unlikely that private capital will be available for many years for hydraulic development on any large scale, powers should be obtained to enable the State to assist or to undertake such development if thought advisable.

It is suggested that much might be done to attract private capital, if the State, after careful investigation, were to guarantee a suitable minimum interest on the necessary capital, sharing at the same time in any profits beyond the amount necessary to provide that interest. By this method of assistance private enterprise would be untrammelled, and the management of the concerns so assisted would remain in private hands.

The following is an abstract of the report:—

In spite of the meagreness of the information regarding vast stretches of the Empire, sufficient data are available to show that its water-power resources are in the aggregate enormous; but with the exception of Canada and New Zealand, Tasmania, New South Wales, and possibly South Africa, practically nothing has been or is being done on any systematic basis, to ascertain its true possibilities.

To enable the Empire to recover from the financial burden imposed by the war, it will be necessary to develop its latent resources. Energy is required to enable the mineral ores to be won and refined. It is required for the adequate fertilisation of the land, as well as for the harvesting and transportation of its crops and products; and any scheme for the extensive development of the Empire's resources as a whole, must depend upon the preliminary development of its energy supplies.

While solid and liquid fuels are convenient to handle, can be easily and cheaply transported to any convenient locality, and, in many cases, form, at present, the most convenient and cheap source of power, their supplies are strictly limited, and their ultimate depletion is assured. Fortunately public opinion is now awakening in some degree to the necessity for their conservation. Long before the supplies are actually exhausted, increasing scarcity is bound to put up their cost to a level much higher than that now obtaining.

In view of this, the utilisation, to the utmost possible degree, of the water-powers of the Empire becomes of paramount importance. Excepting the comparatively small supply of energy obtainable from vegetable growth, these at present provide our only practical perennial source of energy.

The economic development of many of our tropical dependencies, whose latent wealth is practically untapped, is directly interconnected with the development of their water-power resources.

The power now being used in the various countries of the world is estimated to be of the order of 120 million H.P., made up approximately as follows:—

World's factories, including electric lighting and street railways ...	75 million H.P.
World's railways	21 million H.P.
World's shipping	24 million H.P.

This includes all steam, gas, and water-power.

Of the 75 million H.P. used for factories and general industrial and municipal activities, a rough approximation of the most probable distribution would appear to be:—

	United Kingdom.	Continental Europe.	United States.	British Dominions and Dependencies.	Asia and South America.
Millions of H.P. ...	13	24	29	6	3

An estimate by the Dominion Water-Power Branch of the Canadian Department of the Interior, outlines the hydraulic situation of the various countries, as follows:—

Country.	Population (latest available figures).	H.P. available (1915 estimate).	H.P. developed (1915 estimate).	Per cent. utilised.
United States ...	92,019,900	28,100,000	7,000,000	24·9
Canada (A)... ...	8,033,500	18,803,000	1,735,560	9·2
Canada (B)... ...	8,000,000	8,094,000	1,725,000	21·0
Austria-Hungary ...	49,418,600	6,460,000	566,000	8·8
France	39,601,500	5,587,000	650,000	11·6
Norway	2,302,700	5,500,000	1,120,000	20·4
Spain	18,618,100	5,000,000	440,000	8·8
Sweden	5,521,900	4,500,000	704,500	15·6
Italy	28,601,600	4,000,000	976,300	24·4
Switzerland ...	3,742,000	2,000,000	511,000	25·5
Germany	64,903,400	1,425,000	618,100	43·4
Great Britain ...	40,831,400	963,000*	80,000	8·3
Russian Empire† ...	182,182,600	20,000,000	1,000,000	5·0

Canada (B) refers to the most thickly populated portion of the Dominion.
Canada (A) includes the area indicated by (B) and includes the 8,000,000 population of (B). The powers given are a 1917 estimate.
* The estimate for Great Britain is almost certainly much too high.
† A recent estimate by the Ministry of Ways of Communication (ELECTRICAL REVIEW, February 22nd, 1918).

From this it appears that between 15 and 16 millions of the world's industrial horse-power is at present developed from hydraulic resources. The following table shows approxi-

mately the hydraulic power developed in the various regions, and also the ratio of this to the total industrial horse-power, excluding railways.

	United Kingdom.	Continental Europe.	United States.	Colonies.
Millions of H.P.... ...	·08	6·5	7·0	2·0
Percentage of total industrial H.P.	0·6	27·0	24·0	33·0

The United Kingdom is the most backward in this respect of all the countries listed, except Russia.

Any estimate of the total amount of potential water-power in the Dominions and Dependencies of the Empire must be looked upon as highly speculative. The main powers are in Canada, India, New Guinea, and New Zealand, and it is fairly certain that in these countries alone there is a potential water horse-power of the order of 40 millions.

The developments in engineering science in the past decade, more particularly in electrochemical, electrophysical, and electrometallurgical processes, and in the possibility of high-voltage electrical transmission have removed some of the reasons for the comparative neglect of water-power in the past. Electrometallurgy and electrochemistry have rendered it possible to handle materials not workable by any other means; have made available new materials; and have greatly cheapened the production of many important materials of wide use. Aluminium, calcium carbide, chromium, cyanide, silicon, and carborundum, the products rendered commercially possible only by electrical processes, while alkalis, hypochlorate, phosphorus, magnesium, and sodium nitrate are produced most economically by such processes. Great developments have recently taken place in the production of electrolytic copper and zinc and in the electric smelting and refining of metallic ores. All these processes demand relatively large amounts of energy. The world's production of calcium carbide, for example, was 340,000 tons in 1913, requiring 400,000 continuous E.H.P. for its production, while the power used at the end of 1915 for electric furnaces in the United States alone was approximately 300,000 E.H.P.

In the utilisation of atmospheric nitrogen for the production of nitric acid and the manufacture of nitrates, great developments have taken place during the last decade, and in Norway alone over 400,000 E.H.P. is now absorbed in its production. The world's annual consumption of nitrogen in its various combinations is about 750,000 tons, representing a value of about £50,000,000, and this demand is increasing yearly. Four-fifths of this supply has been produced hitherto from natural nitrate deposits, but in view of the rapid depletion of these deposits, and of the diminution in the fertility of most of the great wheat and cotton-growing areas of the world, the production of artificial fertilisers by one or other system of nitrogen fixation must, in the near future, become a question of national importance.

At the present time the world's consumption of fertilisers amounts to close upon 6,000,000 tons per annum, and this will probably be doubled within the next 20 years. To-day, the efficiency of the electrical production is low, amounting in the case of calcium nitrate to about three-quarters of a ton per E.H.P.-year. By adopting the cyanamide process the consumption of energy may be cut down to about one-fourth, but even in this case the production of the equivalent of 12,000,000 tons of fertilisers per annum would require 4,000,000 continuous E.H.P.

It is estimated that the 200,000,000 acres of arable land in Canada alone may ultimately require some 10,000,000 tons of nitrates per annum to maintain their fertility, and this in itself would necessitate the absorption of an appreciable portion of the whole hydraulic energy of the Dominion. When to these demands are added those of India, Australia, and Africa, it is evident that the fertiliser demand of the Empire will in itself call for an enormous supply of energy.

Apart from these requirements, which are admittedly for the future, electric power has a wide and practically unlimited field as a motive power conveniently and economically adaptable to any class of service. In the heating and welding of metals as a part of the process of manufacture, electricity by its control, speed, and concentration or distribution, has many advantages over coal or gas.

Electric railroads have not as yet attained more than interurban and terminal use. The electrification of trunk lines, which demands the supply of cheap electric power at frequent intervals along the route, and involves a very large capital outlay, has not as yet become commercially attractive, but the future possibilities in this respect are enormous.

The considerations already outlined would indicate that the conservation and utilisation of the water-power resources of the Empire is likely to be one of the most important problems in our political economy.

In view of the immensity of the interests involved, it is urged that nothing short of statutory control of these developments is desirable. So far as is possible private enterprise should be encouraged, but under conditions which would prevent the perpetual rights being lost to the community.

While it is essential that the State should have the right of ultimate purchase, the period of such purchase should not be unduly short or the terms too onerous. It will be remembered that such legislation had the effect of severely handicapping the electric power and lighting industry in the early days of its development.

The cheapness or dearness of energy is purely relative, and hydraulic powers which are not at present able to compete economically with steam may in the not-distant future be able to do so. Even now, in favourable localities, the cost of electric power generated from hydraulic installations compares favourably with that of steam or oil power.

The cost of such power is made up mainly of charges against capital, interest, depreciation, sinking fund charges, taxes and insurance, which are usually much greater than water charges and costs of operation, maintenance and supplies. These capital charges vary widely with the local circumstances and physical characteristics of the site.

An examination of some 120 European installations shows that for large installations of upwards of 10,000 E.H.P., the minimum cost of the hydraulic works is £8.4 per H.P. installed, and the maximum, £79.6 per H.P. For the majority of the installations the cost lies between £25 and £45. The cost of the electrical generators, switchboards, &c., and transmission lines, also varies greatly, ranging from £1.25 to £28.4 per H.P., while the cost of the turbines ranges from £4 to £8 per H.P. The working costs vary between £1.3 and £6.8 per E.H.P.-year, with an average value of £3. From these figures it appears that on the average, making an allowance of 15 per cent. for interest and depreciation, the cost per E.H.P. per annum is in the neighbourhood of £10.5.

In many installations, however, the cost is very much less than this. The Ontario Power Company, for example, is able to supply power to the Hydro-Electric Commission of Ontario at £1.8 per E.H.P. per annum. It is estimated that many of the large powers in Canada can be developed at a total cost, including all generating machinery and transmission lines, ranging from £12 to £20 per E.H.P., in which case the cost per H.P. per annum should not exceed £2 to £3.

In spite of the great importance of water-powers, many of the potential powers in existence must of necessity prove economically useless, either on account of their great distance from centres of industry, the lack of transport facilities, or from the fact that the storage necessary to give a continuous or fairly continuous supply would be too costly. In the majority of cases the extent to which a scheme is capable of economic development can only be determined after a careful examination of the catchment area and of the site of the proposed works; after a careful and prolonged investigation of the rainfall and run-off records; and, especially in an undeveloped country, after an investigation of the mineral and forestal or agricultural possibilities of the surrounding region.

It has usually been understood that the usefulness of a water supply depends on the possibility of maintaining its uniformity over the whole period of the year, and that the maximum useful power is strictly limited by the minimum power which, by the aid of any suggested storage system, will be available towards the end of the longest probable period of drought.

Where the power is utilised for the supply of some industrial centre this is undoubtedly true, but if the idea were to be generally adopted, it would cut out an enormous aggregate of potential power, more particularly in tropical and semi-tropical countries. The possibility of utilising flood supplies for seasonal operations in connection with mining, agriculture, and forestry, or for the production of nitrates in such cases, would appear to be worthy of close consideration.

In any case, the possibilities of a given scheme can only be determined after a prolonged hydrographical and meteorological investigation of the site and surroundings. To be of real value such an investigation should extend over a long series of years.

(To be concluded.)

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Future of Coal Using.

Mr. Booth's article in your issue of August 9th points out that when the waste heat from steam or gas engines can be usefully conserved the big power station is put out of consideration.

There are many practical difficulties in utilising the waste heat of exhaust gases and the jacket water of gas engines; as Mr. Booth says, the problem is an easier one with steam power.

In paper mills, salt works, chemical works, &c., where the latent heat of steam can be utilised for drying or evaporation; and even in factories requiring considerable heating, this utilisation of the latent heat of steam has long been practised.

Turbo-generators of the "reducing" type are then adopted, and such proportion of the steam as can be utilised for drying, heating, cooking, &c., is drawn from the low-pressure stages of the turbine, while the surplus steam goes on to the condenser, transferring its latent heat to the condensing water. When no drying or heating is required, it is undoubtedly economical to transfer all the latent heat of steam to the condensing water.

Mr. Booth's suggestion is that if small electric supply stations used non-condensing steam engines, utilising the exhaust steam by distributing heat to replace fires in living rooms and kitchen ranges in residential areas within a limited radius, the heat demand would probably outrun the heat supply, when the electricity would become a secondary product.

In America, central stations supplying steam for heating and cooking are successful in city areas; but for residential areas, even in climates involving five months of winter heating, the individual house is the unit of central heating. A single low-pressure boiler, usually fired with anthracite, but in some cases using town gas or occasionally natural gas fuel, is adopted, with radiators in each room; while both gas and electricity are used for cooking.

In the typical instance of the large industrial city of Detroit, Michigan, with which the writer is familiar, there is practically no possibility of enemy attack, but for reasons of coal and water supply, as well as of power distribution, the two riverside electric power stations are miles apart; while the central heat supply is totally distinct, five separate heating stations being used in street areas. Full information as to the latter is given in the illustrated article, pages 646 to 650 of *Power*, May 7th, 1918, by Mr. Walker, of the Detroit Edison Company.

A town plan is given showing how the heat distribution centres closely around the principal and central street, Woodward Avenue; the actual buildings receiving heat are clearly shown, the residential areas being practically untouched.

Grouped near together, in the busiest area of the City of Detroit, are the three principal central heating plants, all generating live steam at 125 lb. pressure in water-tube boilers with archless furnaces and multiple-retort underfeed stokers, giving smokeless combustion and high boiler efficiency over a wide range of load; labour is minimised by this automatic stoking. There are no railway facilities in these street areas, but coal is hoisted to the overhead bunkers from street lorries, which also remove the incombustible ash.

Live steam is distributed over limited city areas at 30 lb. steam pressure, so that 10 lb. steam pressure, as required for cooking purposes, can be guaranteed at the service valves of the consumers.

The two older central heating stations are being converted for identical live steam supply. They were designed as lighting and power plants, with non-condensing engine sets and large mains to distribute exhaust steam; but this practice is now quite obsolete.

While multiple-retort underfeed stokers are assembled from units to suit any size and any make of water-tube boiler, eliminating manual labour and requiring no brick arches, and so giving maximum thermal efficiency and minimum upkeep in all sizes, these features have rendered large boiler units practicable, with undoubted advantages in space, in first cost, and in working costs over small units; and at Detroit, increasing sizes of boilers and stokers have been adopted for their central heating stations.

Thus, in the latest city plant, at Congress Street, the present boilers have 13,000 sq. ft. heating surface each; and it is intended to add three double-edged boilers, each with 23,654 sq. ft. heating surface, having an undivided archless furnace, with two 13-retort underfeed stokers, precisely like the double-ended boilers which supply the 50,000-K.V.A. turbo-generator at the Conner's Creek waterside power station.

Double-ended boilers, each with 20,700 sq. ft. heating surface, at the Bow power station of the Charing Cross Electricity Supply Company, London, are now being fitted with two 12-retort continuous-cleaning Erith-Riley underfeed stokers; for convenience of working they are, however, divided into two individual units by a central wall. The feed-water is heated by auxiliary exhaust, and no economiser or induced-draught fan is used; the Detroit boiler-houses follow the identical practice, getting very high boiler efficiency with archless furnaces and multiple-retort underfeed stokers, and extreme simplicity of boiler-house plant.

Erith's Engineering Co., Ltd.,
Charles Erith, *Director.*

London, E.C., *August 10th*, 1918.

Lightning Accident in Kent.

The wording of the report by Major A. Cooper-Key, H.M. Chief Inspector of Explosives, quoted in your issue of 2nd inst., is calculated to convey a wrong impression, and the facts that follow are, I think, necessary to remove this impression.

Early in June, 1917, Major Cooper-Key 'phoned me that he had a case which he thought would interest me, and at an interview that followed I offered to go to Messrs. Curtis's and Harvey's explosives factory to investigate. Mr. G. Scott Ram, M.I.E.E., of the Home Office, accompanied me on this visit.

I looked for traces of lightning conductors on the remains of the five destroyed buildings, but could not find any, and I could not see any on somewhat similar buildings at the factory, though I noticed a few on buildings which were rather taller, and the manager informed me that none had been provided for the lower buildings, it being considered sufficient to protect the taller ones.

The existing lightning conductors there did not interest me as they did not affect the liability of the ones destroyed to be struck. I cannot, therefore, state whether they were likely to be effective for the buildings on which they were placed, in any case, but I distinctly recollect remarking to the manager that one building, near which we happened to be standing, was not sufficiently protected, and explaining how, by an inexpensive addition, it could be improved.

I enclose copies of my report to Major Cooper-Key on this case, and his reply, which I have his permission to publish.

At an interview I had recently with Major Cooper-Key, he explained that he was mainly interested in the fact that nitro-cellulose dough digesting in alcohol should have detonated, which experts on explosives would regard as remarkable, and the matter of lightning conductors was a subsidiary one. He did not intend to imply that *all* the factory buildings were provided with lightning conductors, but that buildings *at* the factory, i.e., some of them, were so provided, and I think it probable that in stating "the protection against lightning would seem to have been as good as could be devised" he was quoting the opinion of the owners of the factory rather than expressing his own view.

Alfred Hands, M.I.E.E.

London, E.C., *August 10th*, 1918.

[copy.]

91, Leadenhall Street, London, E.C.,
June 9th, 1917.

Major A. Cooper-Key,
H.M. Chief Inspector of Explosives,
Home Office, Whitehall, S.W.1.

Dear Sir,—I regret that my visit to —— did not enable me to ascertain how the damage by lightning occurred there. The buildings were so far cleared away that there was really nothing left to investigate.

The buildings that were exploded or fired had no lightning conductors, except that one was adjacent to a small tower on which there was a conductor. Though there were higher structures in their neighbourhood which were fitted with conductors, the destroyed buildings were all liable to be struck, and they may all have been fired by direct lightning strokes, but I do not think this occurred. The description given—fires breaking out simultaneously in all the buildings—suggests that most of, or possibly all, the effects were due to lightning having struck one spot, and the fires breaking out at others owing to induced or surging electrical effects causing sparks where there happened to be, in the buildings, danger gaps between metals that had not been rendered safe by connections made across them.

Explosions or fires in explosives buildings may be caused in two ways:—

1. By the building being struck by a flash of lightning.

2. Through sparks occurring in the interior owing to induced or surging effect caused by a lightning stroke to some other object within a radius of about half a mile of the building fired. Such an effect might even occur (and I think I have seen cases in which it has) without a lightning flash actually occurring between a cloud and the earth, but through induced sparks—echoes of an equalisation of disturbed electrical equilibrium taking place in the clouds overhead.

In the protection against lightning of danger buildings, (1) appears to be all that is generally provided against; (2) is largely ignored, because the matter is not generally understood. But since a spark one-eighth of an inch in length, if occurring in a suitable place, would suffice to ignite or explode such contents as there usually are in these buildings quite as effectively as a direct flash passing through it, and with the same ultimate result, i.e., total destruction, extending perhaps to other buildings, the provision of defence against (2) is, I consider, of even greater importance than against (1), because the likelihood of its occurrence is greater. That a comparatively low structure, covering only a few hundred square feet of ground, will be directly struck by lightning may appear a rather remote contingency, but that another object within a radius of half a mile of it (with or without lightning protection) should be struck, and induced or surging effects occur in the smaller and lower structure, appears to me to be very much more probable.

No doubt, in the course of time, the owners of such buildings will realise this danger, and protection against it will become general, but at present it is only resorted to in comparatively few cases.

The explosion, at ——, of a substance contained in metal cases, and therefore each comprising in itself a Faraday cage, may have been caused by an induced spark occurring between two of them. Such a spark might, I consider, cause sufficient heat in the metal case of one (or both) at the point of contact to cause ignition of the contents. I understand these were standing promiscuously. If they happened to touch one another there would be no effect; if there existed a small gap between, the spark would be liable to occur.

Where I have come across such cases I have recommended that the metal containers should stand on a metal floor- or shelf-covering, or that strips of metal should be laid so that, whatever their position, they would always be in metallic connection with one another. Whether these metals should, or should not, be connected to the conductor system proper,

or otherwise "earthed," has depended on the existing circumstances.

The part that puzzled me in the —— case is the fact that all the buildings, even those that contained neither explosives nor explosives in an inflammable stage, should have been completely ablaze in a few seconds. One wants to know what was the medium that enabled the fires to spread so rapidly. Merely dry woodwork would not account for it; and I do not think that ruberoid roofing would. In some cases I have found such buildings lined with a highly inflammable felt, and with such I could understand the very rapid spread of the fire.

In order to be able to discover the cause of such occurrences, I think one would require to have seen the buildings before the event, in which case I think one should be able to foresee what would happen, or to examine them immediately afterwards, when there would perhaps be something still visible that would enable one to form an opinion.

I am, dear sir,
Yours faithfully,
(Signed) Alfred Hands.

[copy.]

Home Office, Whitehall, S.W.1,
June 11th, 1917.

Dear Mr. Hands,—Very many thanks for your letter of the 9th instant, giving the result of your visit to ——. It is a great pity that you were not able to see things as they were before the accident happened, but your observations are nevertheless of great interest to me, and are most instructive. I am still, however, very much puzzled as to why the explosion in the metal cylinders occurred. I can imagine them being set on fire, but it is most remarkable that an instantaneous detonation should at once follow.

Yours faithfully,
(Signed) A. Cooper-Key.

Alfred Hands, Esq.,
91, Leadenhall Street, E.C.3.

Trade Unions: Past, Present, and Future.

If your correspondent, Mr. Woolley, had set out to expose the trade unions, he would have succeeded admirably, but his letter, as an attempt to vindicate them, has failed miserably.

He states in the first place that "all unions adopt the policy of the majority," and follows this up by saying, "all strikes since August 4th, 1914, have been unofficial, and against the leaders."

It is therefore absolutely certain that the so-called "leaders" do not lead; that they do not represent the majority, with whom alone can rest the decision to strike.

If this majority are willing to be led by the "Bolchies, conchies, and aliens," in spite of their "patriotism" and the advice of their so-called "leaders," then there is something very wrong with modern trade unionism. It does not require even "average intelligence" to see that.

"A fair day's pay for a fair day's work," says Mr. Woolley, but excellent as this principle undoubtedly is, he falls into error in his method of bringing it about. "The trade unions state your rate of pay," he says, "and the employers see that you do the work."

The result of this can only be industrial tug-of-war and antagonism, each side being out to score off the other; but Mr. Arthur Henderson, M.P., whose "time and experience counts" in trade unionism, speaking at Brighton on June 22nd, 1918, said: "The idea that the relationships between Capital and Labour must necessarily be antagonistic must be abandoned."

The antagonism can only be abandoned when the trade unions enforce both sides of the bargain. They alone can guarantee a fair day's work in return for a fair day's pay, by the process of expelling from the unions all members who have not "qualified" by their willingness to perform such work.

Thus will the unions encourage production, and thus will they raise the level of trade unionism, and Mr. Woolley, whether he likes it or not, will, sooner or later, have to come into line with these ideas.

Our gallant lads in France and on our other fronts, who have suffered through the strikes, official or unofficial, will be the governing factor after the war, and it is of these that the trade unions must beware, for they have had the real "experience."

The Writer of the Article.

August 10*th*, 1918.

As a student of trade unionism, I have read with much interest the article and letter upon the above subject in the issues of the Electrical Review for July 19th, August 2nd, and August 9th, and I must express myself in perfect association with the article of July 19th, and the views expressed by "Electrical Fitter," which are fully justified and reasonable, and are shared with a multiplicity of others. It is *not* a man's trade merits or qualifications that decide his admission as a member, at least to the E.T.U., as Mr. Woolley seems to infer to "Electrical Fitter." This is a great source of dissension among existing trade unionists and the cause of many not becoming members. Again, Mr. Woolley's remarks with regard to the recent strikes are evidence of the lack of control and the state of disorganisation affecting trade unions and their business ineptitude, savouring of party politics, and their socialistic propaganda, with all its attendant evils and failings, and whose common view and highest standard of uplifting and improving the status of the worker, lies wholly and solely in forcing up wages, which is now, or ought to be, an exploded fallacy.

The time has now arrived when trade unions should be reconstructed upon sound reasoning and broad views, and business competency, with *real* uplifting qualities and education, measures that would be welcomed by present members and non-members alike.

I fully agree with the article of the Electrical Review for July 19th, and I am prepared in every sense to take an active and prominent part in the reconstruction of at least the trade union for electrical industries, and to give the benefit of my studies and researches to the producing community, who are the people who matter.

John A. Tasker.

Battle, *August* 12*th*, 1918.

The Problem of Reconstruction.

The loss of world wealth must be made good as rapidly as possible, and at the same time, the condition of the workers improved.

All industries do not produce wealth equally rapidly, for an industry which produces a value equal merely to a living wage, creates no wealth at all. The importance of an industry to the world and to a nation (but not to an individual) depends thus on the average amount of skill utilised therein, for if a skilled man does not produce a greater value per hour than an unskilled, what would be the use of skill? By skill is not meant, of course, merely manual skill, but the use of brains, intelligence, organisation, &c., attuned to a greater production.

The value of an industry expressed in money, is the sum of the profit of the employer plus the wealth wage of the workers, the latter being the difference between the wage paid and the living wage. Thus an industry which can afford to pay high wages owing to the high value produced, is of far more importance than an industry which pays low wages, even if the latter yields a fortune to the employer. This would apply to every nation, so that its skilled industries are of the utmost importance. And a nation without skilled industries cannot become wealthy.

In an unskilled industry producing merely a living wage there can be no international competition save at the price of the starvation of the workers, and the more skilled it is the greater will be the competition, and it will pay one nation to under-sell another in skilled industries until the whole of the profits and the wealth wage of the workers has disappeared, if by so doing that industry can be weakened or destroyed. Thus even under universal free trade the larger nation can undersell the smaller, so that the skilled industries of the latter can be destroyed, and universal free trade is incompatible with the right of existence of small nationalities.

Protection of skilled industries, far from inducing perpetual war, will permit each nation to develop its own wealth, without interference, and lead its own life, whereas universal free trade would penalise a nation which wished to work shorter hours and set greater store on the happiness of its inhabitants, as compared with mere wealth production.

The effect of protection on the power of a nation to compete in neutral markets is nil, for the following reasons:—

Although the cost of production to an individual is the sum of the price paid for all material and total cost of all wages, it is not the national cost of production, for the wealth wage represents merely a transfer of wealth from the employer to the employé, and the national cost of production is the sum of the value of the irreplacable raw material and the living wage of all the workers. This is evidently unaffected by protection or any artificial increase in prices or wages, the first result of protection being thus a tendency to depreciate the internal value of money.

It can, therefore, be stated that the first factor in reconstruction is that we (and every nation) should reserve to ourselves those industries which produce the greatest wealth per worker, and this, of course, includes all key industries, with the result that not only will wealth be produced most rapidly and shorter working hours become possible, but that owing to the high value produced a number of workers will be set free to improve the condition of all the inhabitants.

Voting money for housing and education will not improve either, but solely the availability of surplus labour and the production of a greater surplus wealth which may be divided among the non-producers.

Trading operations do not produce wealth, but are part of the cost of production, and when they result in a greater efficiency they help to produce wealth just as does efficient labour.

J. S. Hecht.

August 1*st*, 1918.

THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

From the electrical standpoint the British Scientific Products Exhibition, which opened at King's College, London, on August 12th, falls slightly below expectations, inasmuch as it has not been possible to make this section fully representative of developments since the outbreak of the war. The reason for this, however, is perfectly obvious, and after making due allowance for the circumstances which have tended rather to restrict the nature of the electrical exhibits, it must be admitted that the collection is indeed an impressive one. As to the exhibition itself, it is satisfactory to think that the aims which the promoters had before them have been realised in an adequate manner, and the collection of products and appliances of scientific and industrial interest, which, prior to the war, were obtained chiefly from enemy countries, but which are now produced in the United Kingdom, furnishes striking evidence of the awakening which has come over British industry, and of the growing appreciation on the part of manufacturers of the *rôle* of science in industry.

The aim of the exhibition was admirably stated by Prof. R. A. Gregory in the course of an address which he delivered on the opening day, August 12th. To Professor Gregory, as chairman of the Exhibition Organising Committee, the success of the exhibition is in no small measure due, and he, together with his colleagues, deserves the gratitude of the industry for their achievement.

Industrial advance depends upon three main factors, in all of which brain and hand are related. First, there is the creative investigator whose work reveals new properties and relationships; then comes the inventor or industrial researcher who seeks to apply knowledge to useful ends; and when a practical process or machine has been devised, the artisan is needed for its construction or technical use. Each of these three classes has an essential place in national life, and the correlation of their interests and activities should be the chief aim of statecraft. It is not too much to say that since the advent of the war much more intelligent attention has been paid to this problem of effective co-ordination than was given in earlier years. The spirit of distrust which formerly existed between scientific workers and manufacturers has been largely, but not entirely, dispelled, and an alliance is being formed which should go on increasing in strength for the benefit of each and the promotion of national prosperity. The man of science formerly confined himself too much to an academic atmosphere, and did not trouble to understand the problems of industry, while the manufacturer neglected to avail himself sufficiently of the potential industrial developments represented by the rich stores of scientific knowledge accumulated in the laboratory. During the last four years, however, science and industry have been brought into closer relationship, and some of the results of this *entente cordiale* are shown in the British Scientific Products Exhibition.

Professor Gregory, in the address to which we have referred above, explained that the aim of the exhibition "is to stimulate public interest and confidence in the capacity of British science combined with industrial enterprise to secure and maintain a leading place among progressive nations; and the object is the full development of our mental and material resources." It has been popularly assumed that original scientific work has been almost a prerogative of Germany, whereas a slight acquaintance with scientific history shows that most modern industries have originated with British science and invention. In purely scientific research of initiative quality we have been the pioneers; where we have been deficient is in the practical use of the results obtained, and the application of our natural scientific genius to the solution of industrial problems. Under the stress of war, and protected from the dumping methods which strangled promising industries almost at their birth, the opportunity has arisen of proving the latent capacities of many of our scientific industries. The result of what has been accomplished in several notable directions is to be found at King's College.

One of the most important articles which used to be imported almost exclusively from Germany was the magneto. When the war broke out it became necessary for British makers to start up this industry under difficult and urgent conditions. Apart from suitable design there was the problem of producing good permanent magnets, but by persistent efforts all difficulties were overcome, and there are now nine British firms engaged in this work, with the result that during the past four years 300,000 magnetos have been manufactured for war service alone. What is equally important is that the home-made magneto is now as good as, and even superior to, the previously imported Bosch machine. Representative types are shown on the stand of the British Ingition Apparatus Association, which comprises the following companies: British Thomson-Houston Co., Ltd., Coventry; British L. M. Ericsson Manufacturing Co., Ltd., London; British Westinghouse Electric and Manufacturing Co., Ltd., Manchester; E.I.C. Magnetos, Ltd., Birmingham; Fellows Magnetos Co., Ltd., Park Royal, N.W.; M.L. Magneto Syndicate, Ltd., Coventry; Thomson-Bennett Magnetos, Ltd., Coventry; R. B. North and Sons, Ltd., Watford; and C. A. Vandervell and Co., Ltd., Acton Vale, W.

Another interesting feature of the exhibition is a display of insulating materials which were formerly almost exclusively supplied by German and Austrian producers. Varnished insulating cambrics, silks, and papers, and moulded insulation, suitable for the various kinds of electrical work, are now produced in large quantities in this country, and although we are not yet entirely independent of outside producers for this class of material, the manufacture of these has now been firmly established in this country, and there is every likelihood of the demands of consumers being satisfied by British producers. One of the reasons for the backward state of the magneto industry before the war was the lack of a satisfactory insulating material suitable for this class of high tension apparatus. Types are now shown at the exhibition having dielectric strength which withstands a pressure of more than 20,000 volts per mm. thickness, and does not carbonise under sparking. The latter is of supreme importance for running contacts as used in magnetos and rotary engine distributors.

It is not possible to do more than merely indicate briefly some of the outstanding features of the electrical section of the exhibition, and we must defer a detailed description for a future issue. But it must be said that the degree of progress indicated by the exhibits is surprisingly great, and even where no striking development has occurred in the way of new invention, there is a marked general improvement in apparatus constructed on the recognised lines of pre-war days. Satisfactory evidence of the development of the drawing of tungsten into wire of very small diameter for use as filaments in electric glow lamps is to be found in the fact that one firm alone is now exporting over 600,000 metres of tungsten wire per week to foreign markets which would otherwise be taking supplies from Germany. A development in electrochemistry shown at the exhibition is the electric furnace. Although electric furnaces made progress for some years past, it was the war that brought them into prominence. It then became evident that this type of furnace was exceedingly useful for dealing with the immense quantities of steel turnings obtained in the manu-

facture of shells, and for making special steel alloys of great importance to aircraft. In this connection, reference may be made to "stalloy," an alloy due to Sir Robert Hadfield, which is remarkable for its low electrical losses. The reduction in losses by use of this alloy in transformers for electric power has probably effected a saving of some ten million pounds sterling per annum, and this saving is continually increasing.

In conclusion, it may be well to indicate some of the directions in which this country was dependent upon Germany before the war for various electrical products and the way in which these needs are being met. Apart from the magneto to which reference has already been made, another direction in which this country was largely dependent on Germany and Austria was in carbons for arc lamps. Fortunately, one British firm undertook the manufacture of such carbons, although subjected to ruthless price-cutting through dumping—the price falling from 40s. to 18s. for a certain quality and size. Still more fortunately, this firm did not fall a victim to our lack of national foresight, and so we are now in a position to be self-supporting in this direction also.

Reference has already been made to electric lamp filaments. Glass bulbs for glow lamps were also mainly imported. Although this is no longer the case, the position is by no means satisfactory, because it is very difficult to develop manufacturing of this kind, which is largely dependent upon carefully trained labour (*i.e.*, young men), which labour is necessarily in great demand by the military authorities. There is no reason, however, why we should not be in a position to supply our home requirements in this line also under proper conditions, and to manufacture on a large scale.

During the war much progress has been made in the manufacture of resistance wire, which was largely imported from Germany. The same is true of electromedical apparatus, of which, it is stated, 75 per cent. was of German manufacture. These examples are sufficient to show that British manufacturers are capable of supplying our needs, and of producing a thoroughly sound product. It will remain for the British public, after the war, to give the necessary support if this position is to be maintained.

(To be continued.)

WAR ITEMS.

Exports to China.—The "London Gazette" for August 8th contains a further list of persons in China to whom exports may be consigned.

Non-Ferrous Metal Industry Act.—In the Board of Trade Journal for August 8th, the eighth list of licences granted to firms under this Act is published.

Martial Law in E. Africa.—At Nairobi, East Africa, an electrician, formerly employed by the Magodi Soda Lake Co., Ltd., was fined by the resident magistrate five hundred rupees for having left his employment without permission, whilst another European was fined three hundred rupees for giving the electrician employment. The cases were brought under the Martial Law Regulations.

"End of the War": Select Committee's Definition of the Term.—The Select Committee on Emergency Legislation has decided that the date of the end of the war "in relation to the powers conferred by emergency legislation should be held to be the date when the Treaty of Peace is finally binding on the respective belligerent parties, that is, the date when ratifications of the Treaty are exchanged or deposited. This is on the assumption that the war is ended by a general treaty of peace between the United Kingdom and all the Powers with which the United Kingdom is at war." If this country were to make a separate treaty of peace with an individual enemy Power, the end of the war with that Power would be the date when the ratifications of the treaty were exchanged or deposited.

Radio-Active Substances.—The Minister of Munitions has issued an Order prohibiting the purchase, sale, or delivery of any radio-active substances, luminous bodies, or ores without a permit. Applications in reference to this Order should be addressed to the Controller of Optical Munitions, Ministry of Munitions, 117, Piccadilly, W. 1.

New Exemption Order.—The Ministry of National Service is about to issue a new list of certified occupations. In the meantime, men of certain specified trades are not to be called up even for medical examination. The new list will include public utility services and engineering trades; it will cover electrical engineers. Experience gained by the Ministry indicates that it is essential to maintain the efficiency of the trades concerned by exempting an adequate number of skilled workers.

Exemption Applications.—At Walthamstow, E. F. Cole, civil service messenger (41, grade 3, married), appealed because of his wife's health. For three years he had been doing part-time tramcar driving at week-ends. Four months was allowed.

At St. Albans, Wm. C. Millard (50, grade 2), electrical engineer, appealed, and said that he had been for over 20 years with Messrs. Smith, and had charge of 50 motors. He was given three months.

At Southport, the Birkdale District Electric Supply Co. appealed for the retention of their engineer (31, grade 2), they having failed to secure a substitute. It was stated that a discharged soldier had been engaged, but he had had no experience, and would have to be trained. The calling-up was delayed until November 1st.

At Bath, an appeal was made by Edgar Rudge (48, grade 1), electrical engineer and apparatus maker, who claimed to be in a certified occupation. He said that he maintained the X-rays installations at the local civil and military hospitals, and the Royal United Hospital secretary said that he was the only man in the city they could turn to if anything went wrong with the electrical apparatus. Three months was granted.

A National Service appeal against exemption held by E. H. Packman (44, grade 1), electrical engineer at Henley Park Hospital, Surrey, has been withdrawn.

At Maidstone, three months was conceded to W. Clement (38, grade 3), electrical fitter at the Corporation pumping station.

Windermere tribunal has granted conditional exemption to Jas. Thornborough (39), electrician.

High Wycombe Tribunal has granted six months' temporary exemption to E. H. Milner (40, grade 2), electrical engineer, of Oxford Street.

The Bourne End (Bucks) Electric Installation Co. appealed for Frank Wootten (45, grade 2), electrical engineer, stated to be supplying electricity to 90 houses in the district, including the residence of Sir Arthur Pearson. He was allowed six months.

BUSINESS NOTES.

Holidays.—Fleming, Birkby & Goodall, Ltd., Woodfield Mills, Liversedge.—Works and offices closed from August 31st to September 7th (inclusive).

Change of Address.—The Concordia Electric Wire Co., Ltd.—From August 17th all communications should be addressed to the company's new works:—Trent Mills, New Sawley, Derbyshire. Telephone No.: Long Eaton 249.

Fuel Economy.—The question how the householder shall calculate the amount of coal to which he is entitled, and draw up his requisition for electricity or gas in accordance therewith, has been conveniently answered for gas consumers by Mr. R. J. Angel, borough engineer of Bermondsey, who has prepared a comprehensive table showing all the possible proportions of coal and gas supplies for houses from 1 to 20 rooms. Unfortunately, the only reference to electricity is to the effect that ½ ton of coal must be deducted for each 200 units of electricity, and the assumption is made that every user of the scale will take at least his minimum allowance of gas for lighting. No mention is made of the fact that no gas at all need be taken, a nominally equivalent allowance of electrical energy being substituted if desired. This defect greatly detracts from the value of the table for electricity supply consumers, but might be remedied by the addition of a printed slip. Copies of the table can be had from the *Contract Journal* Co., Ltd., 127, Temple Chambers, E.C. 4.

"Fuller" Safety Lamps Approved.—The Home Secretary has issued an order approving of the Fuller miner's safety electric lamp in all mines to which the Coal Mines Act, 1911, applies, subject to the conditions specified in the schedule of the order.

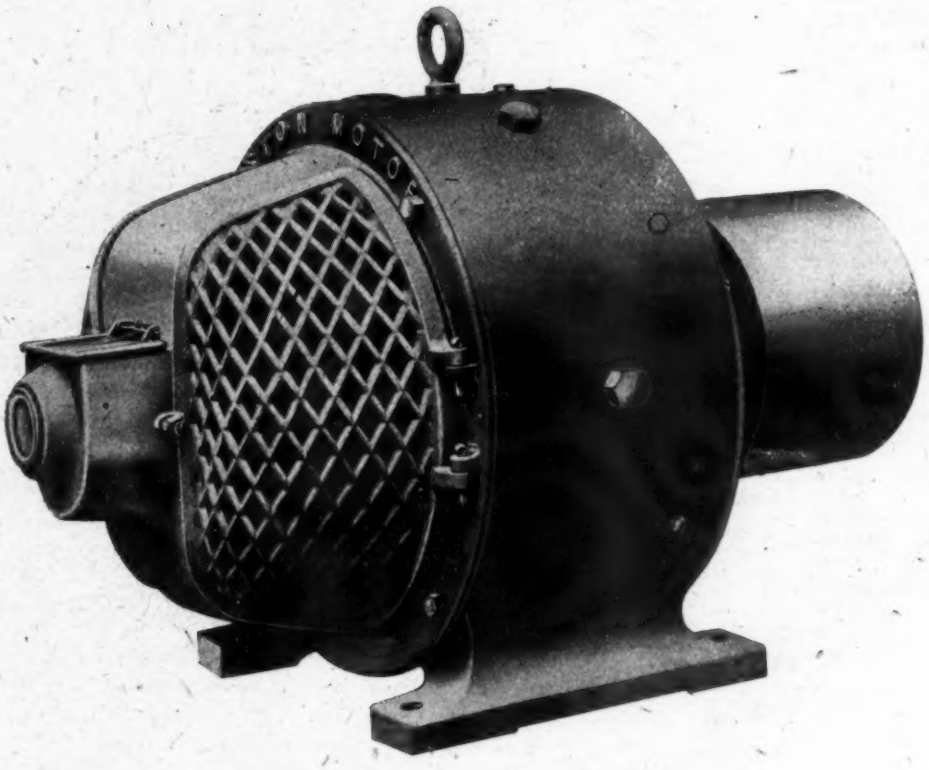
High-Duty Stokers for Low-Grade Coal.—The report of Mr. Magoris, acting electrical engineer for Hull Corporation, points out that a recent sample of the coal allocated to them by the Coal Controller contained no less than 30 per cent. of incombustible ash, as against about 8 to 10 per cent. of ash in the case of their pre-war coal. For boilers with furnaces 15½ ft. in width, the Hull Electricity Works' fourth order for Erith-Riley stokers is for the High-Duty pattern of this fully automatic stoker, 33 per cent. more capacity than previous ones, and suited for a normal duty of 3 tons of coal hourly. As nearly 1 ton will be incombustible ash, the continuous-cleaning feature of the Erith-Riley Stoker is invaluable, eliminating all manual labour.

Erith's Engineering Co., Ltd., are now delivering to the Bow power-house of the Charing Cross Co. Erith-Riley Stokers for a normal duty of 3 tons of coal hourly each.

VERITYS LTD

ENGINEERS,

WORKS: ASTON, BIRMINGHAM.



"ASTON" STANDARD MOTORS.

QUICK DELIVERY
OF ALL SIZES,
$\frac{1}{6}$TH B.H.P TO 200 B.P.H.

SALES DEPOTS

LONDON: 31, King Street, Covent Garden, W.C. 2.

BIRMINGHAM: Phœnix Chambers, Colmore Row.

BRISTOL: 59, Victoria Street.

GLASGOW: 51, Waterloo Street.

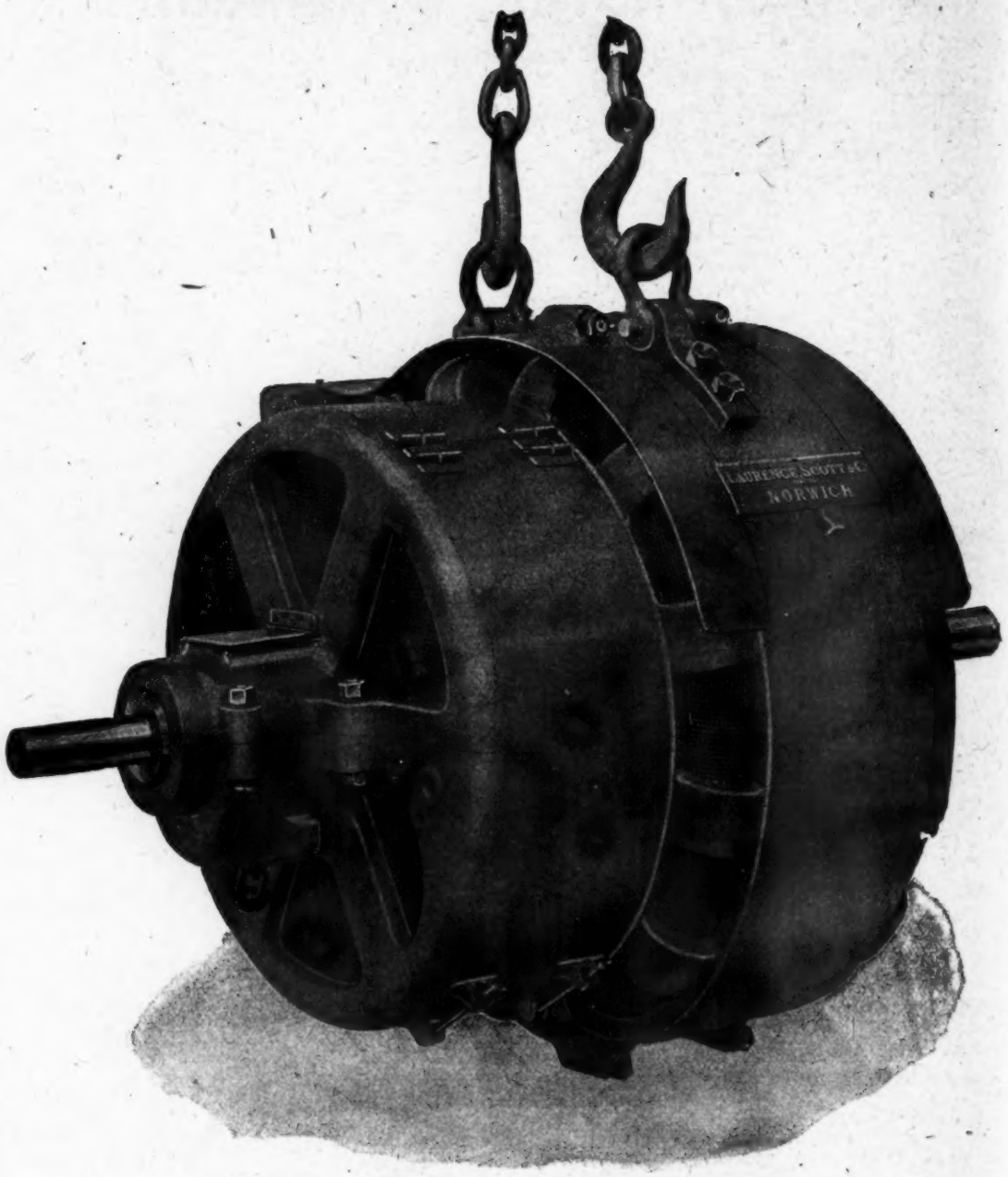
MANCHESTER: Hardman Street, Deansgate.

LIVERPOOL: 518, Royal Liver Buildings.

NEWCASTLE-ON-TYNE: Edinburgh Life Assurance Buildings, 21, Mosley Street.

M. 119

E



SHIP'S MOTOR, WITH FEET ARRANGED FOR FIXING TO VERTICAL BULKHEAD.

"BANQUO" SYSTEM (Registered).

AS SUPPLIED IN LARGE NUMBERS TO ARSENALS, DOCKYARDS, EXPLOSIVES WORKS, CHEMICAL WORKS, FACTORIES, ETC.

SINGLE POLE 5-AMP. SWITCH.

"BANQUO" IRON-CLAD DISTRIBUTION SWITCH SYSTEM.

Supplied Single or Double-Pole.

This System will commend itself to engineers as an improvement on the practice of mounting a number of switches inside the same box as the fuseboard and in place of straggling single units. The switches are mounted on one iron base, this being usually fitted in proximity to the distributing fuse-box. The switches are foolproof, and saving is effected in cost and labour. The words "ON" and "OFF" are cast on the lid, and the switch handle is of cast gun-metal, giving a substantial yet neat appearance. The boxes can be drilled & screwed to requirements, and there is ample space inside cases for safety and ease in wiring.

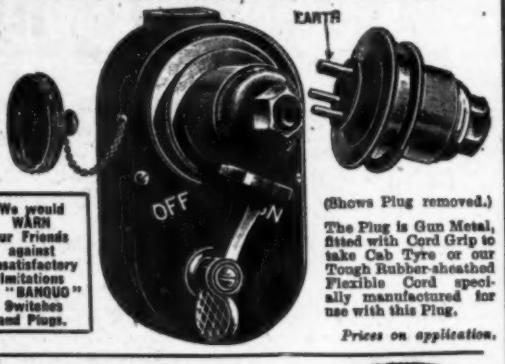
With loose or removable keys, 1/4 per way ex.

NUMBER OF SINGLE POLE 5-AMP. SWITCHES.

1	2	3	4	5	6	7	8	9	10	11	12
5/0	9/4	14/-	18/8	23/4	28/-	32/8	37/4	42/-	46/8	51/4	56/-

Prices for Double-Pole and 10-amp. Switches on application.

"BANQUO" SAFETY INTERLOCKING COMBINED WATERPROOF SWITCH AND 3-PIN PLUG.



(Shows Plug removed.)

We would WARN our Friends against Unsatisfactory Imitations of "BANQUO" Switches and Plugs.

The Plug is Gun Metal, fitted with Cord Grip to take Cab Tyre or our Tough Rubber-sheathed Flexible Cord specially manufactured for use with this Plug.

Prices on application.

"BANQUO" Power and Heating Switch Plug Set.

Waterproof Pattern.

Combined Double-Pole SWITCH, with Interlocking Plug, so arranged that the plug can only be inserted or withdrawn when the switch is in the "OFF" position.

No. A9/20, cap. 5 amps. 22s. ea.
" A9/21, " 10 " 35s. "
" A9/22, " 15 " 45s. "

DOCK AND FACTORY HEAVY CURRENT WATERTIGHT PLUGS.

As supplied to the War Office, and important Government, Railway and Dock Contracts.

Made in 2 or 3-pin plug type from 10 to 600 amps. capacity.

These plugs are substantially well-made. They are fitted with stout earthing connection, which make connection first and break connection last. A protecting cap is fitted with a chain which prevents the current-carrying parts from exposure when plug is out.

Ward & Goldstone SALFORD MANCHESTER

Teleg.: "Multum," Manchester. Telep.: 7088-4-5-6 Central.

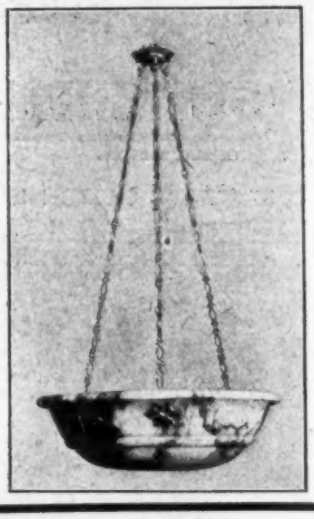
LONDON Offices: 59, New Oxford St., W.C.

GLASGOW Office: 50, Wellington Street.

OUR NEW SECTIONAL LIST OF INSULATORS, SWITCHGEAR, FUSES, ELECTRICAL ACCESSORIES, WIRES, CABLES AND FLEXIBLES, IS NOW READY. SEND US A P.C. for LIST No. 104.

N-K SPELLS O-K

BOWL FITTINGS



BIG STOCKS

WRITE FOR ILLUSTRATED LISTS.

BRADFORD: Fitzwilliam Street.

NAPIER-KIMBER, LTD.,

109, GT. PORTLAND STREET, LONDON, W. 1.

Telegrams: "APIERIMBER 'PHONE. LONDON."

Telephone: MAYFAIR 3860.

GLASGOW: 200, St. Vincent St.

BLACKPOOL: 8, Somerset Avenue.

THE

TAYLOR-SCOTSON PRESSURE REGULATOR

Highest Accuracy & Efficiency, Minimum of Attention, for

A.C. and D.C. POWER STATIONS

MAINTAINS CONSTANT VOLTAGE UNDER ANY NORMAL WORKING CONDITIONS.

Automatically Controlled Booster Sub - Stations

maintain constant pressure in outlying districts without increasing section of Feeders.

Saves COPPER and LABOUR.

Three Wire Booster and Taylor-Scotson Regulator.

Sole Makers–

COX-WALKERS, LTD., Darlington.

WANDSWORTH

London Offices and Stores:
165, WARDOUR STREET, W.
Telegrams: "Wemcolim, London."

Head Office and Works:
LUDGATE HILL, BIRMINGHAM.
Telegrams: "Current, Birmingham."

THE WANDSWORTH SWITCHPLUG IS FOOLPROOF

(PATENT).

IT IS SELF-CONTAINED. NO SEPARATE SWITCH IS REQUIRED. IT IS AUTOMATIC IN ACTION, THE RAPID MAKE AND BREAK SWITCH MECHANISM BEING OPERATED BY THE INSERTION OR WITHDRAWAL OF THE PLUG.

IRON CLAD FOR USE IN WORKSHOPS.

MADE IN 5 & 15 AMP. SIZES.

GAS TIGHT.

WATER TIGHT.

IRONCLAD OR HARD WOOD COVERS.

KEITH CENTRIFUGAL FANS.

KEITH FAN
(Motor Driven).

FACTORY VENTILATION.
GENERATOR COOLING.
DUST REMOVAL.
SMOKE EXHAUSTING.
INDUCED DRAUGHT.

For blowing or exhausting large volumes of air through duct work with highest efficiency, specify the KEITH FAN.

JAMES KEITH & BLACKMAN CO., LTD.,

27, Farringdon Avenue, LONDON, E.C. 4.

Kelvin, Bottomley & Baird, Ltd.
16-20, Cambridge Street,
Glasgow.

PORTABLE
VOLT—AMMETER
Moving Iron.

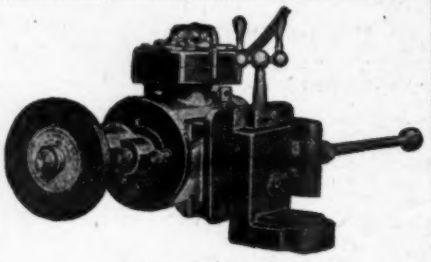
KELVIN
Portable
Instruments
for
A.C.
&
D.C.
Write for Prices.

PORTABLE AMMETER.
3 RANGES SELF-CONTAINED.
Moving Iron.

PORTABLE WATTMETER.
Dynamometer Pattern.

ELECTRIC TOOL POST GRINDER.
No. M. 2850.

Motor runs at 10,000 R.P.M., giving the emery wheel the right surface speed. The arm fits into the side rest of any ordinary lathe, in the same manner as any turning tool. Specially useful for quick and accurate grinding of centres, dies, cutters, &c. Weight 5½ lbs. **Ref. No. M. 2850.** Supplied complete with flexible cord. B.C. adapter and emery wheel.



SUN ELECTRIC
TOOL POST GRINDER.
Ref. No. M. 2855.

This grinder is provided with adjustments which allow a wide range of grinding operations to be carried out expeditiously and accurately. It is quickly fitted to the slide rest and the vertical adjustment of 1¾ inches enables the wheel to be quickly set in position for grinding. The off-set head is adjustable, so that wheels can be set either close in to the work or on outer position for larger diameters of work. For light internal grinding requiring speed of 8000 R.P.M., a special head can be supplied. Supplied complete with 4-in. Emery Wheel, Switch, Flex & B.C. Adapter.

SUN ELECTRIC
TOOL POST GRINDERS.

Here are shown, together with brief particulars, two most useful tools for your tool room, machine shop, &c. Instantly available for use from any electric lamp socket, they will enable you to obtain fine limits of accuracy on jigs, tools, &c.

The complete range of Sun Portable Electric Tools is fully illustrated and described in List No. 283. Write for your copy to-day.

The SUN ELECTRICAL COMPANY LIMITED

118-120, CHARING CROSS RD., LONDON, W.C. 2.

Telephone: *Gerrard 2291 (3 lines).*
Telegrams: *"Secablis," Ox, London.*

BRANCHES:
BIRMINGHAM—30, Paradise St. DUBLIN—43, Dame St.
BELFAST—Scottish Temperance Buildings, Donegal Street.

CRYSELCO

METAL FILAMENT LAMP

Manuractured only by the

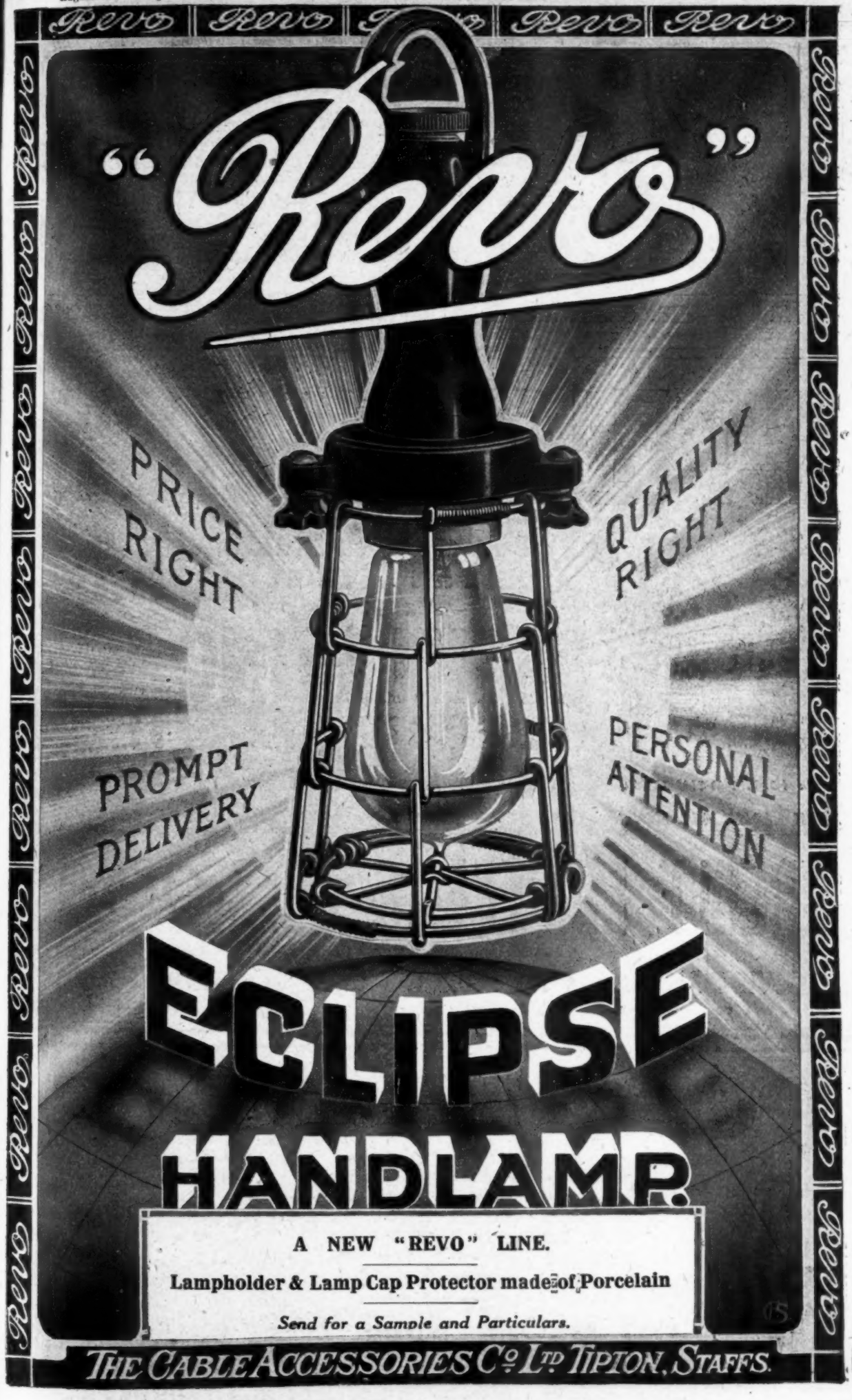
All-British Lamp Company,

CRYSELCO, LIMITED,

Kempston Works,

BEDFORD.

Telegrams: "Cryselco, Kempston." Telephone: 117 Bedford.


"Revo"
PRICE RIGHT
QUALITY RIGHT
PROMPT DELIVERY
PERSONAL ATTENTION
ECLIPSE
HANDLAMP
A NEW "REVO" LINE.
Lampholder & Lamp Cap Protector made of Porcelain
Send for a Sample and Particulars.
THE CABLE ACCESSORIES Co. Ltd. TIPTON, STAFFS.

MICA MFG Co

Manufacturers of

MICANITE.

HARD BROWN MOULDING SHEETS; FLEXIBLE MICANITE, IMPROVED QUALITY for COMMUTATOR SEGMENTS (milled dead to gauge); MICAFOLIUM (sheets and rolls), MICA CLOTH and PAPER, MOULDED RINGS, TUBES, TROUGHS, BUSHES, WASHERS, &c., &c. INSULATING PAPER BOARD (ordinary and high grade Admiralty quality).

MICA.

CUT and GAUGED (or roughly trimmed pieces). MICA SPLITTINGS, &c., &c.

VOLTA WORKS, CAZENOVE ROAD, LONDON, N.

Telegrams: "OMICAMANU, LONDON"
Telephone: DALSTON 2608.

MARELLI'S NEW TYPE

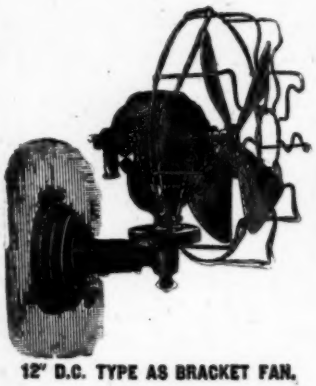
or

SWIVEL and TRUNNION, DESK and BRACKET

— 12' & 16' —

A.C. & D.C.

OSCILLATING FANS.



12" D.C. TYPE AS BRACKET FAN.

WE MAKE ALL KINDS of ELECTRIC FANS for any TENSION or PERIODICITY.

ERCOLE MARELLI & CO. (of Milan)

Works: Sesto S. Giovanni.

LONDON, E.C.: FAN HOUSE, 19-20, Garlick Hill, Queen Victoria St., E.C.

Telephone: CENTRAL 784. Telegrams: AURETTA, CANNON, LONDON. Cables: AURETTA, LONDON.

POROUS CELLS

& PLATES

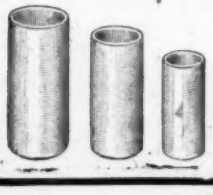
CONTRACTORS TO G.P.O. AND COLONIAL GOVERNMENTS.

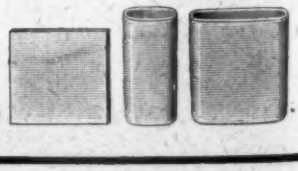
WHITE EARTHENWARE (EMPTY),
for Electrical and Scientific Purposes.

EXTRA POROUS, for Accumulator and Electrolytic.
ORDINARY, for Leclanche.
HARD, for Acid and Bichromate.

Telegrams: "MALING, NEWCASTLE-ON-TYNE."

'Phones:
599 Central, Newcastle-on-Tyne.
331 City,
12539 Central, London.





C. T. MALING & SONS Ford Potteries, NEWCASTLE-ON-TYNE.

ESTABLISHED 1762.

VICKERS LIMITED

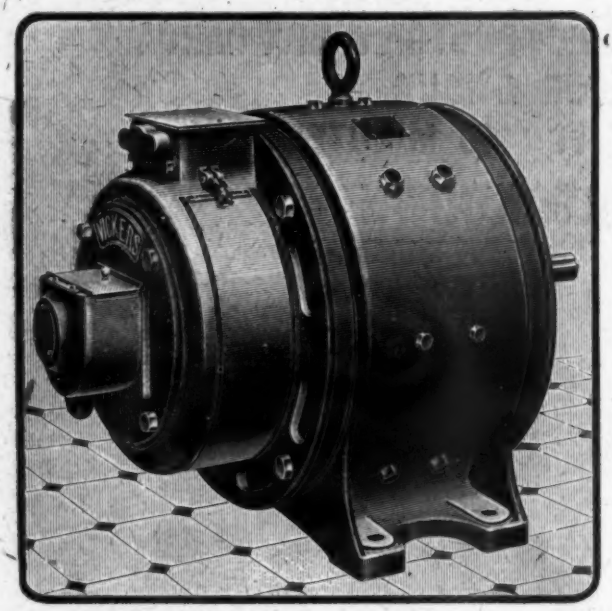
Proprietors of

THE

Electric & Ordnance Accessories

WARD END WORKS, Company Limited, BIRMINGHAM.

Telegrams: "E.O.A., BIRMINGHAM." Telephone: EAST 960



VICKERS MOTORS.

Of modern design and strong construction, they can be relied upon to give continuous and satisfactory performance, irrespective of working conditions, and without assistance from the repair shop.

High overload capacity with high efficiency.

Agents:

LONDON: *Electrical Department,* Vickers House, Broadway, Westminster, S.W.1.
MANCHESTER: R. Foster, 196, Deansgate.
MIDLANDS: Bill & Berry, 39, Great Charles Street, Birmingham.
GLASGOW: J. & A. Anderson, 231, St. Vincent Street.
NEWCASTLE-ON-TYNE: T. J. Grainger & Co., 21, Mosley Street.

Agents:

NOTTINGHAM: F. Mansfield, 197, Station Road, Beeston, Notts.
SWANSEA: W. Ogden Dayson, 1, Mount Street.
YORKSHIRE and THE TEES: F. MacCallum, Austhorpe Road, Crossgates, Leeds.
SHEFFIELD: H. E. Ridley, Park Road, Wadsley Lane.

30,000 VOLT CABLE JOINT

PATENT Nos. 21646/13—6093/15.

ABSOLUTE RELIABILITY PROVED BY LARGE NUMBER IN USE UNDER SEVERE CONDITIONS

TEST PRESSURE

BETWEEN CONDUCTORS

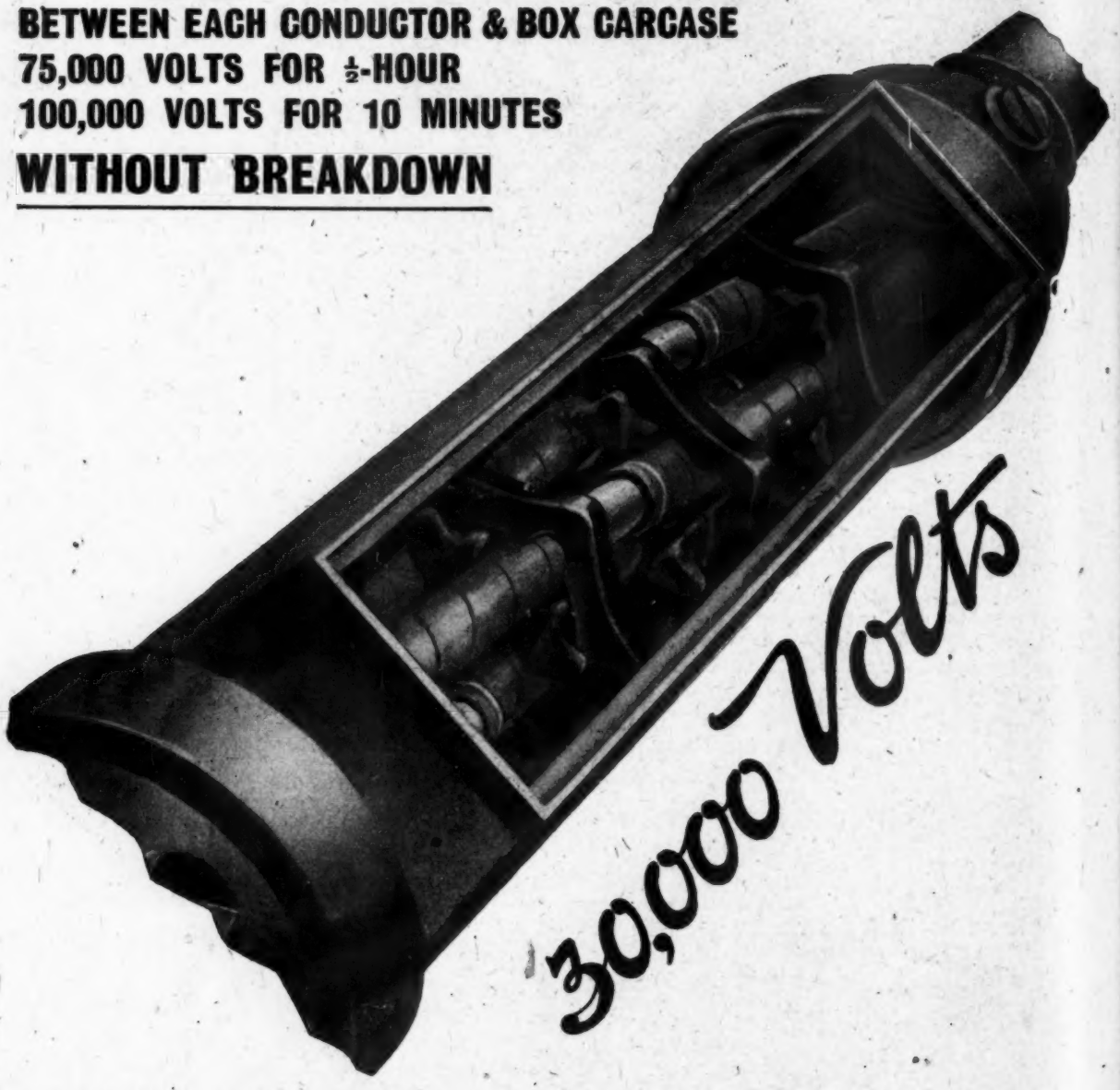
AND ALSO

BETWEEN EACH CONDUCTOR & BOX CARCASE

75,000 VOLTS FOR ½-HOUR

100,000 VOLTS FOR 10 MINUTES

WITHOUT BREAKDOWN



W.T.GLOVER & Co., LTD.

TRAFFORD PARK,
MANCHESTER.

THE "ELECTRICAL REVIEW"

CHEAP PREPAID ADVERTISEMENTS

Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY per Word (minimum 1s.). Box Number and "Electrical Review" Address count as Seven Words.

LATEST TIME FOR RECEIVING 9.30 a.m. THURSDAYS.

Where Advertisements are to be answered to a given Number at the "Electrical Review" Office, applications for Names and Addresses of the Advertisers will be entirely disregarded, and Letters giving incorrect Box Numbers will be destroyed.

*** The Scale does not apply to Trade Advertisements, terms for which can be had on application to 4, Ludgate Hill, London, E.C. 4.

OFFICIAL NOTICES, &c., 1s. per line in Column.

The ELECTRICAL REVIEW is the recognised medium of the Electrical Trades, and has by far the LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

Unless otherwise instructed, **ALL LETTERS** received in answer to Advertisements with a Box number, **ARE FORWARDED NIGHTLY.** Postages incurred are charged at cost.

NOTICE TO ADVERTISERS.

EVERY care is taken to ensure the prompt insertion of all Advertisements, and accurate delivery to Advertisers of replies to their Advertisements, but the Proprietors and Publishers do not guarantee the insertion of an Advertisement on any specified day, or at all, and will not be liable for any loss occasioned by the failure of an Advertisement to appear on any specified day, or at all, from any cause whatever.

Advertisements and replies are only accepted subject to the above conditions.

VALUATIONS, AUCTIONS and ARBITRATIONS of

Electrical Works, Plant and Stock.

WHEATLEY KIRK, PRICE & CO.

(Established 1850).

46, Watling Street, London, E.C. — **16, Albert Square, Manchester.**

26, Collingwood Street, Newcastle-on-Tyne.

By Order of the Receiver.

TO ENGINEERS, MANUFACTURERS AND OTHERS.

BLACKWALL ENGINEERING & WELDING WORKS, Ld.,

221, WESTFERRY ROAD, MILLWALL, E.

PLANT and MACHINERY,

COMPRISING,

Lathes, Drilling and Shaping Machines, Angle Iron and Plate Bending Tools, Hack Saws, Tanks, Time-Recording Machine Tools, Stores, Stock of Electrical Fittings, &c.

LEOPOLD FARMER & SONS

WILL SELL THE ABOVE BY AUCTION

on the PREMISES, in LOTS,

On Thursday, 22nd August, 1918.

Catalogues of the AUCTIONEERS, 46, Gresham Street, E.C. 2, and 61, High Road, Kilburn, N.W. 6.

NOTE.—A BENZ 30-CWT. MOTOR LORRY will be included in the Sale. 2284

SITUATIONS VACANT.

Latest time for receiving 9.30 a.m. Thursday.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

BOROUGH OF RAWTENSTALL.

Shift Engineer.

WANTED at once, Shift Engineer for the Electricity Works (Certified Undertaking). Applicant should have experience with Lancashire and water-tube boilers, steam turbines, and three-phase system. Applications must contain no more than two recent testimonials, and state salary required. To be sent in not later than WEDNESDAY, the 21st instant.

C. L. E. STEWART, A.M.I.E.E.,
Borough Electrical Engineer.

Bacup Road, Rawtenstall,
August 10th, 1918. 2303

JUNIOR ASSISTANT.

WANTED, Junior Assistant in Mains Department. Salary to commence about £170 per annum.

Apply stating fully experience, &c., to FIFE ELECTRIC POWER Co., 8, New Row, Dunfermline. 2304

ASSISTANT CHARGE ENGINEER.

ASSISTANT CHARGE ENGIFEER wanted. Applicants should have had mechanical and electrical training, and experience in the operation of D.C., H.T. and E.H.T. supplies.

Wages £2 10s. per week, plus 20s., plus 12½%.

Apply, stating age and experience, to ENGINEER AND MANAGER, West Ham Corporation Electric Supply, 84, Romford Road, Stratford, E. 15. 2305

SHIFT ENGINEER.

SHIFT ENGINEER wanted at high-tension A.C. Generating Station, having reciprocating and turbine alternators. Salary £2 15s., plus 12s. 6d., plus 12½%.

Apply with information regarding experience and stating whether married to the—

RESIDENT ENGINEER,
Woking Electric Supply Co., Ltd.
(Certified Undertaking),
Surrey. 2323

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

SHIFT ENGINEER.

SHIFT ENGINEER wanted for A.C. and D.C. station (certified undertaking); must have had experience with turbines and E.H.T. 3-phase plant. Wages £3 5s. plus 12½% per week.

Apply, giving full particulars, to the BOROUGH ELECTRICAL ENGINEER, Corporation Electricity Works, Leigh, Lancs. 2314

CHARGE ENGINEER.

CHARGE ENGINEER wanted for shift work. Must be fully qualified man with technical training and experience with Steam Plant, D.C. and E.H.T. three-phase plant. Salary £4 per week inclusive of all bonus.

Apply, giving particulars and references, to 2320, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

ENGINE ROOM ATTENDANT.

ENGINE ROOM ATTENDANT required, with experience in running reciprocating engines and turbines. Applications to be sent to the undersigned, stating wages required.

ENGINEER AND MANAGER,
Electric Power Station,
Bo'ness, Scotland. 2334

SHIFT ENGINEER.

SHIFT ENGINEER wanted for certified undertaking. Must have good experience with Steam Plant and E.H.T. Rotary Converting Plant, and proper technical training. Salary £192 per annum inclusive for all time worked.

Apply stating particulars of age, training, &c., and copies of recent testimonials, to 2321, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CHARGE ENGINEER.

CHARGE ENGINEER wanted, with experience of D.C. 3-wire station, combined with refuse destructor.

Apply, stating, age, experience, together with testimonials and wages required, to BOROUGH ELECTRICAL ENGINEER, Corporation Electricity Works, Bury St. Edmunds. 2342

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

ARMATURE Winders, used to repair shop, D.C. work. No person resident more than 10 miles away, or already on Government work, will be engaged.—Apply H. D. & S., 32, Newington Causeway, S.E. 1686

ASSISTANT Engineer wanted with car-shed experience and preferably with knowledge of power station and mains work. Wages 55s. weekly with 25s. weekly war bonus.—Apply, stating age, medical category, previous experience and references, to THE CHATHAM & DISTRICT LIGHT RAILWAYS CO., Tramway Power Station, Chatham. 2343

ASSISTANT Engineer wanted for small undertaking; capable of executing repairs on consumers' premises and mains work. Knowledge of Diesel engines preferred. Salary £150. Must be low category.—2318, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CABLE Jointer (first-class), required for E.H.T. and L.T. cables.—Apply, stating age, experience, wages required, &c., to THE SCOTTISH CENTRAL ELECTRIC POWER CO., Kirk Wynd, Falkirk. 2315

CAPABLE Test Room Assistant wanted. Experience with contactor gear an advantage but not essential, good prospects if suitable. No person already on Government work will be engaged.—Apply, giving full particulars of experience and wages required, to your nearest EMPLOYMENT EXCHANGE, mentioning No. A5824. 2265

CALIBRATORS for moving coil and moving iron instruments. Good wages. Write stating experience and salary required. North London district. Men on Government work, or over 10 miles distant, need not apply.—2322, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CHARGE Engineer for South country station of 1000-KW capacity, three-wire direct. State time required to take duty, age, married or single, experience, references, wages per week of 56 hours.—2346, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

DRAUGHTSMAN required, preferably experienced in L.T. switchboard work and accessories; Birmingham district. No one already on Government work will be considered.—Apply, stating fully, experience, age, and salary required, to nearest EMPLOYMENT EXCHANGE, quoting No. A5790. 5215

ELECTRIC Vehicle Garage and Battery Depôt (London).—Several young men are required as assistants in all classes of vehicle battery work. Technical knowledge and experience in electrical work is desirable, and opportunities will be afforded to qualify as outdoor battery inspectors. Commencing wages at the rate of 9½d. per hour, plus 5s. bonus, for a 50-hour week. No person resident more than 10 miles away, or already employed on Government work, will be engaged.—2317, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRIC Motor Mechanic, experienced in repairs to small motors; permanent progressive job for the right man. State age, experience and wages required. No person resident more than 10 miles away, or already on Government work, will be engaged.—2256, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Power-house Attendant wanted, with turbine and high-speed engine experience. Must be exempt from military service.—Apply with references, MANAGER, Sneyd Collieries, Ltd., Burslem. 2306

ELECTRICIAN for maintenance and installation work. Good pay for competent man. No person resident more than 10 miles away, or already on Government work, will be engaged.—LOCKETT & Co., Electricians to Printers, Dean Street, Fetter Lane, E.C. 4. 5291

ELECTRICIAN-Mechanic (ineligible) required by controlled firm of general contracting engineers, for work in any part of United Kingdom. Must be thoroughly reliable, a good wireman, capable of estimating quantities, attending to A.C. and D.C. motors, engines (gas, oil and steam), &c. Preference to one accustomed to plant work, and willing to be generally useful in erecting general engineering machinery. Permanent position to suitable man. No person resident more than 10 miles away, or already on Government work, will be engaged.—Full particulars experience, age, wages, 5301, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ESTIMATING Engineer required immedialely for control gear sales department, electric engineering work. South coast.—Apply, stating age, qualifications, and salary required, to 2213, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EXPERIENCED Foreman or Forewoman required to take charge of flashing and mounting department, carbon filaments. No person resident more than 10 miles away, or already on Government work, will be engaged.—9728, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREWOMAN or Foreman to take charge of and develop Winding Shop for small Motors in London. Experience essential. First rate opening, permanency, good wages. No person resident more than 10 miles away, or already on Government work, will be engaged.—2282, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

IMPROVER required in Corporation Generation Station; applicants to be ineligible for military service or in a low medical category.—Apply, stating age, experience, and wages required, to 2252, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

JUNIOR Assistant Electrical Engineer, with good theoretical and some mechanical training. Opportunity to gain good general experience.—Apply stating age, experience, salary required, testimonials and form of military exemption, ELECTRICAL ENGINEER, Electricity Works, Grays, Essex. 5254

MAINS Assistant for South country station of 1000-KW capacity, three-wire direct, must be good wireman, have good knowledge of maintenance and erection of motors. State time required to take duty, age, married or single, experience, references, wages per week of 53 hours.—2347, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PATENT Agency. Wanted, a competent man (ineligible) as Electrical-Engineer Assistant in the business of patent agency in a large office in London. Should possess degree or diploma of technical college.—Apply with details of training and experience, and statement of salary expected, to Box 711, Reynell's, 44, Chancery Lane, W.C. 2. 5302

REPRESENTATIVE required by leading manufacturers of lamps and lighting supplies, to travel South-Eastern coast, &c. Salary and expenses basis only. No person already engaged on Government work, or residing 10 miles from London, will be employed.—Write fully, stating age, experience, and salary expected.—2335, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

REQUIRED, Traveller for Wholesale Electrical Company for London District. Good remuneration; experienced. No person resident more than 10 miles away, or already on Government work, will be engaged.—2341, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SHIFT Engineer.—Shift Engineer wanted for C.C. station; steam and Diesel engines.—Apply, stating experiences with copies of testimonials, and state wages required, to the MANAGER, Wycombe (Borough) Electric Light & Power Co., Ltd., Lily's Walk, High Wycombe. 5257

SHIFT Engineer wanted in State Controlled establishment, to take charge of alternate day and night shift. Diesel and gas engines, D.C. plant. Only men not engaged on Government work, and free from military service, also thoroughly experienced, need apply.—Applications, giving full particulars, to be made to your nearest EMPLOYMENT EXCHANGE, mentioning No. A5483. 2226

SHIFT Engineer wanted, 3-wire, D.C., station with battery. Certified undertaking. Babcock & Wilcox boilers and turbine experience preferred.—Apply stating qualifications, age, medical category and wages required, to MANAGING ENGINEER, Banbury and District Electric Supply Co., Ltd., Banbury. 2302

SHOWROOM Assistant, young lady required for West-End Electrical Showroom, with experience. No person resident more than 10 miles away, or already on Government work, will be engaged.—2340, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SWITCHBOARD Attendant required for three-wire D.C. station.—Apply, stating age, full particulars of experience, and wages required, to 2250, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TEST Assistant, with technical knowledge and experience of D.C. and A.C. machines. No person resident more than 10 miles away, or already on Government work, will be engaged.—Write SUBMERSIBLE MOTORS, LTD., Southall, Middlesex. 5263

WANTED, a few Car-Shed Workers, must have had some experience in car-shed work. Work consists of assisting in general overhaul and repair of tramcar trucks. Wages to suitable men 1s. 1d. per hour; if thoroughly experienced 1s. 3d. per hour.—THE MEXBOROUGH & SWINTON TRAMWAYS CO., Dale Road, Rawmarsh, Yorks. 2299

WANTED, Assistant for Purchasing Department of engineering works, experienced correspondent with knowledge of materials and routine. No person already on Government work need apply.—Apply stating age, experience and salary required to your nearest EMPLOYMENT EXCHANGE, quoting No. A5854. 2301

WANTED, by a firm in the S.E. district engaged on munition work, first-class Telegraph Mechanics. No person resident more than 10 miles away, or already engaged on Government work, will be engaged.—State age and experience to 6125, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, by leading engineering insurance company, Electrical Surveyors, having good knowledge of the theory and practice of alternating and direct-current plant.—Applicants must be ineligible for the Army or Navy.—2181, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, General Assistant to Works Manager in an old-established electric lamp factory. Good opening and progressive salary. No person already on Government work will be engaged.—Apply your nearest EMPLOYMENT EXCHANGE, mentioning No. A5667. 2037

WANTED, Man to make himself generally useful in power house, and on distribution system in Midlands, work chiefly occasional jointing on mains, fixing and reading meters, good job. State wages, single or married, and experience.—2331, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED on a Scottish Power Company (Certified Undertaking), a Shift Engineer with good mechanical and electrics' training. Good wages to a man thoroughly experienced in E.H.T. 3-phase work and boiler house control.—Reply giving full particulars, with copies of references, to 1975, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Overhead Linesman accustomed to tramway work, ineligible for military service. Good wages. — Apply GENERAL MANAGER, Tramway Depot, Greenock, N.B. 2198

WANTED soon in up-to-date power house in Midlands, Shift Engineer for six 8-hour watches, and every other Sunday four hours. No shift after 10 p.m. Diesel engines, D.C. generators. State age, single or married, experience, wages required.—2330, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

WANTED, Sub-station Attendant with experience of rotary converters. £14 3s. 4d. per month.—Apply giving full particulars to 2294, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Switchboard Driver for D.C. Power Station. Fitting an advantage, ineligible or discharged.—Apply, stating experience and wages required, to ELECTRICITY WORKS, East Street, Grantham. 2295

WIREMAN Electrician.—Good all-round man required for London. Highest wages and permanency to one suitable. No person resident more than 10 miles away, or already on Government work, will be engaged.—Apply, JAMES EVANS & Co., 10, Bush Lane, Cannon Street, E.C. 2312

WIREMAN wanted by electric supply company (London) ineligible; standard wages and bonus. — Apply, 53, Charterhouse Street, E.C. 5209

WIREMAN wanted for house wiring and general repairs.—State wages, &c., to ELECTRICITY WORKS, Ventnor. 5282

SITUATIONS WANTED.

* Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

ADVERTISER, electrical engineer, desires change. Four years' power distribution experience; five years on design and manufacture of A.C. machinery with leading firm. University graduate.—5289, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, engaged at present on the design and manufacture of heavy electrical machinery, is open for a new post. Wide experience with first-class firm. Good theoretical training.—5286, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, Engineer and Manager to supply undertaking, desires change; 16 years' central station experience. Good organiser and accustomed to the control of men. Commencing salary £350 for permanent post.—5205, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, technical designer of electrical machinery, 10 years' experience, at present with a leading firm, requires change. Sound theoretical training.—5287, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, 12 years' experience in design, estimating, and manufacture of A.C. and D.C. machinery and transformers, desires responsible position.—5288, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Commercial Manager, 14 years' general supply station and contracting experience, desires post progressive firm. Ineligible, energetic, highest refs. — 5311, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer (46) seeks charge of plant; experienced with steam and gas, Diesel oil engines. Work of National importance; country, Yorks. or North District. —5294, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Fitter seeks situation with armature winding experience, A.C. and D.C., and all types of breakdowns.—5299, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer. Fully qualified in construction work and estimating contracts, &c.—5197, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN (age 35) desires berth national importance. Thoroughly experienced in dynamos, motors, lighting, accumulators; erecting or charge of plant preferred. Conversant with steam practice.—BROWN, 601, Romford Road, Forest Gate, London, E. 7. 5279

ELECTRICIAN and Mate seek situation, lighting and power. London district.—"ELECTRIC," 43, Cambridge Road, Barking. 5314

ELECTRICIAN, light, power, telephones, instal, maintain, repairs, seeks job or charge.—JONES, 44, Warwick Road, Edmonton. 5210

ELECTRICIAN wants work of national importance; Grade 3, age 38; power station preferred. — 5295, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

ELECTRICIAN-Wireman seeks situation; lighting and power factory or private plant.—A., 28, Cavendish Dwellings, Allen Street, E.C. 1. 5310

ENGINEER, Electrical and Mechanical, seeks situation; charge of plant, works manager or inspector. Live man, disengaged. —5300, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER, electrical and mechanical (44), ineligible (deafness), 25 years' experience technical, contracting, station, mains (E.H.T. and L.T.). Charge small station or mains work.—5309, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ESTIMATING Foreman Electrician, 10 years' in present situation, wants change.—"ENGINEER," 23, Grotto Road, Twickenham. 5224

FOREMAN-Electrician, practical, with good business training and more than average ability and energy, desires position of trust with prospects, estimating, buying, control of men, &c.; must be war work.—5312, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LAD (16), considerable experience in wiring, seeks situation as wireman's mate.—5298, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MANAGER or Foreman, Electrician-Engineer; power, plant traction, wiring, distribution, estimating, &c. Over 20 years' experience.—5259, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SWITCHBOARD Attendant, ineligible, experienced in alternating and 3-wire D.C. switchboards.—5247, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).
Box Number and ELECTRICAL REVIEW address count as seven words.

FIRM of manufacturers and suppliers of electric traction overhead line fittings, electrical accessories, moulded electrical insulation, and electrical insulating materials, require first-class energetic Representatives for following districts:—(1) Yorkshire, Lancashire, Cheshire, and North Wales; (2) Midlands; (3) South Wales; (4) South of Midlands, excepting London and district; (5) South-east, excluding London and district; (6) Scotland. This organisation is required principally for after-the-war trade.—Apply with full particulars as to experience and remuneration to 2291, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

FOR SALE.

7000 extra heavy S.C. Batten Holders.
4000 S.C. Miniatures.
1000 ½" S.C. Holders.
1000 rose wood Adaptors.

Cheap in large quantities.
2308, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

MACHINERY FOR SALE.

FOR SALE, at Clearing-out Prices before Stocktaking:—

One 2-pole Dynamo, by Laurence, Scott & Co., 150 volts, 25 amps, with pulley and slide rails; just removed from gentleman's mansion. This is an old-type machine, but in thoroughly good condition and guaranteed. £19.

Two Ferranti Meters, capacity 200 volts, 200 amps.: readings 1 to 10,000 units. £3 each.

One brass-cased Ampæremeter, readings 0 to 150 amps., large, heavy instrument. £3 10s.

Two brass-cased Voltmeters, readings 0 to 250 volts. 50s. each.

Two Ditto, readings 0 to 350 volts. 50s. each.

One Ditto, readings 0 to 150 volts. Large size, £3. All above are in perfect order.

One Slate Switchboard, with Voltmeter, 0 to 120 volts, fitted with two double-pole switches. £3 10s.

Quantity of Electrical Fittings, consisting of Switches, Shades, Insulators, Junction Boxes, &c., some new, some been in use, all removed from a mansion. Price £7 10s. the lot, worth double. Sent on approval.

COOK, 5, Elton Road, Bishopston, Bristol.
Telegrams: "Exhaust Bristol." 'Phone: 757. 2319

FOR SALE.—*Continued.*

FOR SALE.

FIVE gross 1-part China Holders; five gross 1-part H.O. Holders; five gross Composition Adaptors; half gross 5-amp. Concentric Plugs; two gross 5-amp. Bow Cut-outs; four gross S.C. Batten Holders; one ½-H.P. 100-volt D.C., 1000 R.P.M. Motor.

Other Motors and Fans available.

2309, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

MACHINERY FOR SALE.

A.C. MOTORS.

3-PHASE, 50-cycle, 440 volts, Slip-ring:—
250, 70, 60, 57, 50, 37, 25 and 10 H.P.
3-phase, 50-cycle, 440-volt, Squirrel cage:—
100, 60, 40, 32, 20, 10, 7½, 5, 3½, 3 and 2 H.P.
3 and 6 H.P., 220 volts, single-phase, 50 cycles.

400/440 Volts, D.C.
3, 5, 5½, 10, 13, 15, 35 and 100 H.P.

200/250 Volts, D.C.
1, 2, 3, 3½, 4, 6, 10, 20 and 30 H.P.

100/110 Volts, D.C.
37½ KW., 690 revs., and 55 KW., 600 revs.

GENERATING SETS.

87-KW., 220-volt, direct coupled Steam Set.		
18-KW., 110-volt,	ditto	ditto
200-KW., 460-volt,	ditto	ditto

C. L. TURNER, 49, Deansgate, Manchester. 2345

FOR SALE.

5, 15, 25, 30-H.P., 440 V., D.C.; 3, 7, 10, 12, 15, 20, 25, 27-H.P., 440 V., A.C., 2 and 3-phase, 50 periods. Switches, Fuses, Starting Gear, Automatic features and Non-automatic.

Cable from 1/18 to 37/12. Ironclad Fuse Distribution Boards, with and without circuit switches, Home Office pattern. Power Circuit Breakers, 2 and 3-phase, from 100—600 amps.

Materials and workmanship, the Best. Technical advice given with quotations if required.

Your enquiries and deliveries, prompt attention.

Apply—
ROBUST MACHINERY,
62, Bradford Street,
Walsall. 2264

TURBO-GENERATOR.

1,000-KW. TURBO-GENERATOR, 500 volts, 50 periods, 3-phase, complete with Switchboard, Cables, Surface Condensing Plant, Piping, and Electrically-Driven Centrifugal Pump, together with a quantity of Spare Parts, the whole practically new and ready for immediate despatch at Liverpool.

Apply—
FRANK GILMAN,
Lightwoods Hill, Birmingham. 2170

MACHINERY FOR SALE.

One	27-H.P.,	825 revs.,	400/500-volt,	B.T.H.
One	25 "	960 "	"	Electromotors, Ltd.
Six	25 "	670 "	"	Lancs. Dynamo Co.
Four	25 "	835 "	"	G.E. Co.
Four	25 "	810 "	"	Siemens.
One	20 "	750 "	"	G.E. Co.
One	17 "	1200 "	"	Electromotors, Ltd.
One	16 "	800 "	"	Morris, Hawkins.
One	15 "	725 "	"	Lancs. Dynamo Co.
Two	10 "	1400 "	"	Electromotors, Ltd.
One	5 "	950 "	"	G.E. Co.
Four	5 "	815 "	"	"
Six	1 "	800 "	"	"

ALL SPEEDS ON 500 VOLTS, DIRECT CURRENT.

Three	5-H.P.,	1300 revs.,	220-volt,	D.C.
Three	1 "	1500 "	"	"
Four	3 "	1400 "	"	"
Four	2½ "	1400 "	"	"
One	15 "	900 "	"	"

And numerous Motors for A.C. and D.C.

OUR OWN STOCK.

Full details with prices from—
C. J. FERGUSON & SONS,
54, Chiswell Street,
London, E.C. 1. 2285

(Continued on next page.)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

50-KW. Steam Generating Set, by Scott & Mountain, direct coupled to Generator, 500 volts, 100 amps., 500 revs.

25-KW. Steam Generating Set, two crank Comp. Engines, direct coupled to two-pole Dynamo, 100 volts, 250 amps., 450 revs.

6·5-KW. Steam Generating Set, by Robey & Co., direct coupled to two-pole Dynamo, 130 volts, 50 amps., 350 revs.

250-KW. Steam Generating Sets, by Willans & Robinson, direct coupled to Clarke Chapman Dynamo, 115 volts, 435 amps., 470 revs.

No. 3 Four-spindle "Acme" Automatic Screw Machine for ⅝" bars.

3½" Centres "Lo-Swing" Lathe on 8' bed.

3" by 36" All-geared head Flat Capstan Lathe, by Jones and Lamson.

Cutting-off Machine, by Carter & Wright, take bars to 5' diam.

6 ft. Arm Portable Electric Radial Drilling Machine, by Kendal & Gent, 2½" spindles, self-act feed.

Richards Horizontal Oil Groove or Waving Machine, with self-act traverse head, self-act feed, T-slotted bed, 2' 2" by 2' 3"

CATALOGUE of Stock MACHINERY. 2-3000 LOTS.
Free on Application. Inspection invited.
THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

R. H. LONGBOTHAM & CO., LTD., WAKEFIELD,

and at Milburn House, Newcastle-on-Tyne.

Tel.: { 44 Wakefield. / 867 Newcastle. } Telegrams: "Engineer, Wakefield."

FOR SALE.

ONE Parsons Steam Turbo Set, 3500 KW., 1200 R.P.M., with alternator field-rotating type and exciter complete; 6000-volt maximum load, 40 cycles.

One ditto, 1500 KW., 2-phase, 2000 volts, 50 periods.

One Willans-Parsons Steam Turbo Set, 1200 KW., with Alternator, 1200 R.P.M., 200 lbs. to sq. in., 11,000 volts, three-phase, complete with exciter, also condensing plant, air, and circulating water pumps, &c.

One 225-KW. Generating-Set, engine tandem comp. type, 300 H.P., with Corliss Valve Gear, &c., B.T.H. Generator, 500 volts, compound wound.

One Surface Condenser, 3400 sq. ft. Cooling Surface, by Cole, Marchent & Morley, complete with pumps, &c. 5277

MACHINERY FOR SALE.

GENERATING SETS, D.C.

One 500-KW. Willans-E.C.C., 420/500 volts.
Three 256-KW. Belliss-Siemens, 460/500 volts.
One 220-KW. Willans-A.E.G., 220 volts.
One 200-KW. Allen-Parker, 460/500 volts.
One 180-KW. Anderson-Mavor 220/230-volt Set.
One 160-KW. Belliss-G.E.C., 460/500 volts.

TURBO-GENERATORS, A.C. AND D.C.

One 1,000-KW. A.E.G. 500 volts, 50 cycles, 3-phase, with condensing plant complete; the whole equal to new.
One 500-KW. Parsons, 460/530 volts, with condensing plant complete.

Apply, FRANK GILMAN,
Lightwoods Hill, Birmingham. 2128

ELECTRIC MOTORS.

SALE or Hire. Second-hand Machines in Stock. ARMATURES and Coils repaired at shortest notice.

THE TITAN ELECTRICAL CO.,
9/11, Eagle Street, W.C.
'Phone: Central 13,191.

CUNNINGHAM, LIMITED.

SMALL Motors and up to 300 H.P. rewound and repaired.

Estimates free. 171, Edgware Road,
'Phone: "5173 Padd." London, W. 2.

FOR SALE.—*Continued.*

GENERATOR SWITCHBOARDS.

IN perfect order and as new:—

One 100/140-volt, 10-KW. size, with circuit-breaker, &c.
One 460-volt, 45-KW. size, with shunt regulator.
One ditto, with change-over switch, and suitable for two generators.
One Battery Charging Board for 55 cells, 60 amps., by Siemens.

DRUMMOND & CO., Middlesbrough. 5249

MACHINERY FOR SALE.

ONE Generating Set Comprising:—
"Howden" Enclosed Compound Engine for 150 lbs. steam pressure, direct-coupled to compound interpole generator, having an output of 300 KW. at 240 volts, 375 r.p.m.; built in 1910, and in first-class order.
Specification and print on request.

THE PHŒNIX ELECTRICAL CO.,
32—36, Broomielaw, Glasgow. 1943

MACHINERY FOR SALE.

ONE 50-KW. Browett-Silvertown Generating Set, 500 volts, D.C.
One 62-KW. Mirrlees Watson-Bruce Peebles Generating Set, 500 volts, D.C.
One 150-KW. Belliss-Silvertown Generating Set, 220 volts, D.C.
One 150-KW, Browett-Mavor & Coulson Generating Set, 250 volts, D.C.
Two 150-KW. Belliss-Bruce Peebles Generating Set, 500 volts, D.C.
One 220-KW. Belliss-Silvertown Generating Set, 500 volts, D.C.

ROBERT WALKER,
2, Oswald Street, Glasgow. 2286

COUNTY BOROUGH OF SALFORD.

THE Electricity Department have for sale two 1,000-KW. direct-current Turbo-Generators, Willans disc and drum type, coupled to Siemens machines, voltage 440-490. Rated output 1,000 kilowatts, with 160 lbs. steam pressure. The sets are in regular commission, practically new, and can be seen in operation, by appointment. Full particulars from the BOROUGH ELECTRICAL ENGINEER, Electricity Works, Frederick Road, Salford. Tenders are invited by SATURDAY, AUGUST 17th, 1918.

L. C. EVANS, *Town Clerk.* 2266

MACHINERY FOR SALE.

THREE 70-H.P. Laurence-Scott Motors, D.C., 220 volts, 520 R.P.M.
One 50-H.P. " " " 220 " 520 "
One 30-H.P. " " " 220 " 670 "
One 25-H.P. " " " 220 " 700 "
One 20-H.P. " " " 220 " 800 "
With rails and pulleys.

ROBERT WALKER,
2, Oswald Street,
Glasgow. 2287

ELECTRIC DYNAMOS AND MOTORS.

MACHINES always available for Sale or hire.
ARMATURES and FIELD COILS rewound or repaired without delay.

'Phone: 5773 Holborn. MACDONALD, SYER & CO., LTD., 295, Gray's Inn Road, W.C. 1. 8485

Cheap prepaid Advertisements relating to second-hand goods and specified Articles are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).

TRADE RATES ON APPLICATION.

Box Number and ELECTRICAL REVIEW address count as seven words.

A.C. Motors, 2-phase, 200 v., 50 ~, 2, 4, 6, 7½, 15, 20, 25, 30, 50, 60 H.P.; single-phase Motors, ½/10 H.P., 100/200 v.; several 190-H.P., 3-phase Motors, 500 v., 50 ~; Motors, several, 30, 35, 50, 60, 100 H.P., 3-phase, 50 ~, 400/440-v., cheap.—5316, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ALTERNATING Motors for Sale, ¼ and ½ H.P. Particulars on application.—BRITISH VACUUM CLEANER CO., Parson's Green Lane, Fulham. 2339

(*Continued on next page.*)

FOR SALE.—*Continued.*

ARE you in want of a good Dynamo, Motor, Gas Engine or complete Generators? if so, communicate at G. NORVALL'S, 242, Goswell Road, Clerkenwell. 5303

BABCOCK & Wilcox Boilers, two, each 11,000 lbs. evaporative capacity. 200 lbs. steam pressure; excellent order; available immediately.—Full particulars from 5242, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BRUSH-HOLDERS to take 1½" × ⅜" brush, by the Westminster Engineering Co., 1800 for sale; Brush-holders to take 1" × 7/16" brush, 1200 for sale; Regulators for small motors, about 100 for sale; Cable, good second-hand, 37/14, 1500 feet for sale.—B. E. WHITE, 140, Southwark Street, London. 5323

CELLULOID Waste for Sale. Two tons inflammable film. Best offers wanted.—5271, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

D.C. Generator, 75 v., 70 a., 4-pole, 1,200 revs., compound wound, modern pulley, slide rails. Price £55, bargain.—5317, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

D.C. Motors, 230 v., ¼, ½, ¾, 1, 1½, 2, 3, 4, 5, 8, 20, 30 H.P.; Motors, 460 v., 1, 3½, 5, 6, 10, 18, 30 H.P.; Motors, 110 v., ¼, ½, 1, 2, 3, 4, 5, 7, 9, 11, 20, 25, 70, 100 H.P.—5318, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

D.C. Starters, to 150 H.P., in all sizes; Shunt Regulators, Voltmeters, Ammeters, Ohmmeter and Generator, 500 v. Slide Potentiometer; ½-H.P., 200-v., 100 ~, single-phase Motor, £8 10s.; brand new enclosed ½-H.P., 230-v. Motor, shunt, £10 10s.—5319, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DYNAMOS, 200/250 v., 21, 60, 100, 450, 650 amps.; Dynamos, 110 v., 12, 18, 26, 30, 40, 50, 60, 70, 90, 100, 125, 520, 950 amps. Several 60/80 v., 60/100 amps.—5320, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DYNAMOS, 3000, 1500, 1000 and 750 amperes at 6 volts; also smaller sizes. Apply for lists.—CANNING & Co., Electro-Platers Engineers, Birmingham. 7769

ELECTRIC Motors and Dynamos, Sale or Hire. Always a large stock of nearly new guaranteed machines. Immediate delivery.—ELECTRO-GENERATOR Co., 1A, Shepherd's Bush Road, W. 'Phone: 488 Hammersmith. 4723

FOR Disposal, 50 Glass Boxes, 8" × 15" × 18" deep outside; also glass tube Separators 13" long, 9/16" diameter. What offers?—2258, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, eight 20-H.P., 500-volt, totally-enclosed Crane Motors. Cheap.—PHŒNIX, 32, Broomielaw, Glasgow. 2233

FOR Sale, Electrolytic Dynamo, 2500 amperes, 60 volts, 300 R.P.M., 8-pole, double commutator type.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 2327

FOR Sale, Modern 300 and 450-KW., 240-volt, direct-coupled Generating Sets for 150 lbs. steam pressure.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 2328

FOR Sale or Hire, 36 D.C. Motors and 13 A.C. Motors. Particulars on request.—E. P. ALLAM & Co., 107, Gray's Inn Road, W.C. 1. Holborn 1280. 2219

FOR Sale, owing to extension and re-arrangement of power plant, a nearly new 600-KW., 460-volt, generating set by Westinghouse. Plant can be seen under steam up till end of August.—2243, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, second-hand 400-volt, 50-period, 3-phase Motors, 25, 30, 40 and 60 H.P., complete with starting gear.—PHŒNIX, 32, Broomielaw, Glasgow. 2236

FOR Sale, Ship Lighting Set, Robey engine, coupled to 4-pole, compound generator, 60 volts, 160 amperes. Equal to new. £150.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 2325

FOR Sale, Traction Booster, comprising: 218-H.P., 440-H.P. motor, coupled to 150-K.W., 550-volt generator. Makers: Brush Electrical Engineering Co., Ltd. Little used.—2242, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, Transformer, 440 volts, 50 periods, 3-phase, to 100 volts, 170 amperes, single-phase. £27.—PHŒNIX, 32, Broomielaw, Glasgow. 2234

FOR Sale, two 50-KW., 230-volt, multipolar, shunt-wound Generators or Motors.—PHŒNIX, 32, Broomielaw, Glasgow. 2241

FOR Sale, 15-H.P., 400-volt, 50-period, 3-phase Motor, with spur reduction gear having a ratio of 4 to 1.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 2329

FOR Sale, 15-H.P., 400-volt, 50-period, 3-phase, squirrel-cage Motor, with spur reduction gear, having a ratio of 4 to 1, complete with starter.—PHŒNIX, 32, Broomielaw, Glasgow. 2237

FOR Sale, 57½-KW., 110-volt, 600 R.P.M., Interpole Generator, by Westinghouse, 1914.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 2326

FOR SALE.—*Continued.*

FOR Sale, 140-H.P., 410-volt, 40-period, 245 R.P.M., 3-phase, slip-ring, 2-bearing Motor. Complete with starter.—PHŒNIX, 32, Broomielaw, Glasgow. 2240

FOR Sale, 140-KW., 550-volt, 400 R.P.M., 6-pole, compound, single-bearing Generator, by Siemens. £350.—PHŒNIX, 32, Broomielaw, Glasgow. 2239

FOR Sale, 150-H.P., 440-volt, 50-period, 285 R.P.M., 3-phase, slip-ring type Motor, with starter. In new condition.—PHŒNIX, 32, Broomielaw, Glasgow. 2235

FOR Sale, 220-H.P., 460-volt, 230 R.P.M., 6-pole, shunt-wound Motor.—PHŒNIX, 32, Broomielaw, Glasgow. 2238

MOTOR-Generator in first-class condition, having Motor 480 volts, D.C., and Generator, 60 volts, 50 amps., 1,300 R.P.M., complete with starter and regulator.—2200, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OFFER.—Two Westinghouse Transformers: One 40-KW., 500/224-volt, 3-phase, 50-period, oil-cooled fitted, voltage regulator, No. B102,355/25,151; 1-KW. ditto, No. B102,356/25,153. One 2-H.P. Westinghouse S. C., 230-volt, 3-phase, 50-period motor, No. 127,244. Also about 600 electric filament globes, in perfect condition. Await best offers.—THOS. HORTON, Merthyr. 5313

ONE loco.-type Boiler for Sale; about 30 H.P., 150 lbs. W.P.—For further particulars apply to FRANK EVANS, Engineer, Electric Works, Llangollen. 2313

ONE 200-KW. Steam Generating Set for immediate sale, Willans-Mather & Platt, 220 or 440 volts. Perfect working condition.—JENNINGS, West Walls, Newcastle-on-Tyne. 1513

PETROL Set, 70 v., 80 a., Crypto; Motor-Generator, 220 v. to 70 v., 80 a.; ditto, 480 v. to 60 v., 80 a.; ditto, 440 v., 2-phase, 50 ~, to 100 v., 20 a.; ditto, 220 v., single-phase, 50/60 ~, to 60 v., 60 a.; ditto, 110 v., 60 ~, single-phase, to 85 v., 35 a.; ditto, 100/200 v., single-phase, to 60 v., 10 a. Cheap.—5321, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PLATING Dynamos, 50, 100, 200, 2500 amps.; immediate delivery.—5322, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TELEPHONE Switchboard, 15-line, good condition, £4.—SEXTON, Warwick Lodge, Hampton Wick, Middlesex. 5283

THREE 8-H.P., 220-volt, brand new, shunt-protected Motors, 1600 revs.; just unpacked.—DRUMMOND & Co., Middlesbrough. 5305

TWO 250-KW. Bellíss Alternator Sets, each comprising a Compound Enclosed Engine, with E.C.C. Alternator, 3000 volts, 50 periods; quite modern, and for immediate delivery.—HARRY H. GARDAM & Co., LTD., Staines. 1852

25-H.P., 3-phase slip-ring Motor, by Siemens, 440 volts, 60 cycles, with short-circuiting device; also complete starting gear.—DRUMMOND & Co., Middlesbrough. 5308

44-KW., 110-volt D.C. Generator, compound wound, three-bearing type, with rope pulley and slide rails; speed, 600.—DRUMMOND & Co., Middlesbrough. 5306

70-B.H.P. Lancashire D.C. Motor, 500 volts, 500 R.P.M., equal to new; 5-B.H.P. Electric Motor, 110 volts, D.C.; slow-speed Dynamo, 25/37 volts, 60 amps., 370 R.P.M.—STANLEY ENGINEERING Co., Bath. 2310

100-KW., 220/240-volt, 6-pole Generator, compound interpole 3-boring type. Perfect order.—DRUMMOND & Co., Middlesbrough. 5307

110-VOLT, 75-amp. bi-polar Dynamo by Scott & Mountain. In perfect running order.—DRUMMOND & Co., Middlesbrough. 5216

175-H.P., 500-volt, 50-period, 290-R.P.M., 3-phase, slip-ring type Motor, with liquid starter. £420.—PHŒNIX, 32, Broomielaw, Glasgow. 2230

300-KW., 230/250-volt, Steam Set; Howden engine, coupled to compound interpole generator. New 1910.—PHŒNIX, 32, Broomielaw, Glasgow. 2232

500-H.P., 440/500-volt, 150-R.P.M., compound interpole, four-bearing Motor, with rope pulley and elaborate control gear. Nearly new.—PHŒNIX, 32, Broomielaw, Glasgow. 2231

500-KW. Steam Generating Set, comprising a Bellíss triple-expansion engine, coupled to an alternator by the Electric Construction Co., Wolverhampton, 3000 volts, 50 periods, with Wheeler-Worthington independent surface condensing plant; modern plant in first-class condition, and for immediate delivery.—HARRY H. GARDAM & Co., LTD., Staines. 1851

500-KW. Steam Set, comprising triple-expansion enclosed engine, coupled to Westinghouse multipolar generator, 440/490 volts, D.C. For prompt delivery.—HARRY H. GARDAM AND Co., LTD., Staines. 1413

ARTICLES WANTED.

COMPOUND ENGINE AND DYNAMO WANTED.

WANTED immediately for cash, Compound Engine and Dynamo, vertical engine; direct coupled preferred. Approximate output 80—100 amps.

DARLINGTON MOTOR & ELECTRICAL CO.,
Commercial Street, Darlington. 2300

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).
Box Number and ELECTRICAL REVIEW address count as seven words.

ACCUMULATORS wanted for refining purposes. Obsolete Generating Sets, Dynamos, Motors, and all kinds of Machinery. Scrap Cable, Arc Lamps, Meters, Metal Residues, and Scrap Metals of every description purchased for prompt cash, town or country.—Apply A. BROWN & SONS, 142, Lower Clapton Road, London, N.E. Telephone: Dalston, 555. Telegrams: Secondhand, Lowclap, London. Established 1860. 4358

A.C. and D.C. Motors (second-hand), any type, any condition, wanted for prompt cash.—A. LEAROYD & SON, Bridge Works, Heatherley Street, Clapton, N.E. 4765

A. LEAROYD & SON, Bridge Works, Clapton, N.E.—Telephone Dalston, 2278; Telegrams: Frangible, Lowclap, London—buys for prompt cash every description of second-hand Generating Sets, Accumulators, Motors, Transformers, old Arc Lamps, Meters, Cable, Scrap Metals, Metallic Drosses, &c., &c. Enquiries solicited. Established over 50 years. 4766

A 1 CASH Prices given for Electric Cable, Flexible Wire, Electrical Accessories, &c.—Apply DAVIS, 11, Sun Street, E.C. 2. 1424

ALL for Munition purposes.—Obsolete Motors, Dynamos, Insulated Cable, and every description of Electrical Plant bought to break up. Send us your stocks of scrap metals.—G. H. CHAPPELL SONS & Co., Midland Wharves, Lea Bridge Road, Leyton, N.E. 'Phone:—Walthamstow 500. Estab. 40 years. 4707

ALTERNATING Motors wanted, several, ¼ to 4 H.P., 200 V., 50 ~, single phase.—METEOR MFG. CO., 72, Gray's Inn Road, W.C. 1. 5285

DYNAMOS, Motors, Arc Lamps, Meters, Scrap Cable, Iron, Metals or Machinery purchased for cash in any quantities.—J. HYAMS, 11, Glengall Terrace, Old Kent Road, S.E. Telephone: 3339 Hop. 5158

DYNAMO, 110 volts, required, about 40 or 50 amps., compound-wound preferred.—TREDEGARS, LTD., 5 & 7, Brook Street, London, W. 1. 5292

MOTOR-Generator, comprising 200-volt, 50-cycle, single-phase Motor (slip-ring), coupled to 70-volt, 80-100 amp. Dynamo.—2289, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MOTOR-Generator, direct-current, 460-volt, Motor, coupled to 150-200 amp., 70-volt Dynamo. Complete.—2290, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MOTOR wanted, 3 or 4 H.P., 220 V., D.C.; give price and particulars.—J. RAWLINSON, 9, Westgate, Burnley. 5284

NEW or Second-hand Tubing and Fittings wanted.—WALLACE, 58, High Street, Bloomsbury. 2307

OLD Cable urgently required, also Lamp Tops.—WALLACE, Cromwell House, High Holborn. 4114

OLD Electric Lamps that have had wire-drawn tungsten filaments in them with glass parts intact, 1½d. each, any make.—104, Craven Park, London, N.W. 10. 5049

OLD Electric Lamps that have had wire-drawn tungsten filaments in them previously wanted, glass parts intact. Agent's price 2d. each.—847, Harrow Road, London, N.W. 10. 4932

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London.

PLATINUM Scrap purchased in large or small quantities. Highest market value given.—Before selling elsewhere call or post to the old and reliable firm, THE DEPÔT, 156, Charing Cross Road, London. Established 1850. 5199

STEEL Tubes, all sorts, wanted; Lampholders and Metal and Cardboard Shades; Gas Lighters, Static Electric; Screws, round head, and Hexagon Nuts.—DUGDILLS, Failsworth, Manchester. 5052

TWO 30-KW., 110-V., 600 R.P.M. compound wound Dynamos; must be modern design.—State fullest particulars to MCBEAN BROTHERS, Electrical Engineers, Batley. 5280

WANTED, a few 400-volt, 50-cycle, 3-phase Motors, preferably slip-ring type, 5 to 35 H.P.—8133, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Battery, 54 cells, 230 ampere-hours capacity, shunt-wound Generator, 140 to 145 volts, 22 amps., for accumulator charging.—W. A. MEADOWS & Co., LTD., Percy Street, Hanley, Staffs. 5243

WANTED, Direct-Coupled Steam Set, any output from 50/100 KW., will be considered; 440/480 volts, D.C.—State full details, price and where seen, to 2311, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARTICLES WANTED.—*Continued.*

WANTED, D.C. Motor, second-hand, 7 to 10 H.P., 400 volts.—5304, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Electric Cooking and Heating Apparatus, Kettles, Irons, Vacuum Cleaners, all voltages. Also Electric Bells, Lamps and Arc Lamp Carbons, and all classes of Accessories and Flexibles.—Fullest particulars to 2316, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Motor, 80-H.P. or over, two-phase, 50 periods, slip-ring type. Must be in good condition, with starters and all accessories. Full particulars, M. ERDMAN & SON, Rollins Street, Old Kent Road, S.E. 15. 2338

WANTED, one compound high-speed vertical Steam Engine, direct coupled to alternating current, three-phase Generator, 50 cycles, 220 volt, and exclusive of exciter; engine to be suitable for steam pressure of 100 to 150 lb.; output required 120 to 130 KW.; set must be complete with all accessories, and absolutely first-class condition and make. State maker, date, and full particulars of plant, also price f.o.r.—2229, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, one compound high-speed vertical Steam Engine direct coupled to D.C. Generator, 220-volt; engine to be suitable for steam pressure 110 to 150 lb.; output required, 50 to 60 KW. Set must be complete with all accessories, and absolutely first-class condition and make. State maker, date and full particulars of plant, also price f.o.r.—5281, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, one 600/800-amp., 50/60-volt D.C. Generator. Also one 600/800-amp., 50/60-volt, single-phase Alternator, 50 periods, with exciter.—JOHNSON, MATTHEY & Co., LTD., Hatton Garden, London, E.C. 1. 2297

WANTED, two A.C. Motors, 110 volts, 60 periodicity, 20/30 H.P., single phase.—Particulars to CRYSELCO LIMITED, Kempston Works, Bedford. 1826

WANTED, two Babcock & Wilcox water-tube Boilers, about 1000 sq. ft. heating surface each, 150 lb. working pressure, complete with fittings and mountings, preferably Hopkinson make; must be in first-class condition and available immediate delivery. Full particulars required, also price f.o.r.—2228, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WE often have enquiries from consumers for second-hand 25-cycle, 3-phase, 440 and 2,200-volt motors. Sellers should send post-card, stating horse-power, age, maker, speed, voltage, squirrel or slip ring, pulley diameter and width, and best price, f.o.r.—MOTOR DEPARTMENT, South Wales Electrical Power Co., Royal Chambers, Park Place, Cardiff. 4624

10 TONS old Transformer or Armature Stampings wanted.—Particulars to 5296, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

110-VOLT D.C. Motors wanted at once, preferably multipolar semi-enclosed type and shunt wound.—SIMPLEX CONDUITS, LIMITED, Garrison Lane, Birmingham. 2337

WORKSHOPS, PREMISES AND SITES TO LET OR WANTED.

TO Let, four good rooms (self-contained) on fourth floor of building on Ludgate Hill; electric light, lavatory, &c.—Apply to PUBLISHER, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4. 4522

MISCELLANEOUS.

SHEET Metal Work Wanted, any kind: best workmanship at moderate prices.—A. V., 26, Pindar Street, Bishopsgate, London, E.C. 5293

NOTICE.

OWING to the many hundreds of replies passing through this Office each week, we would ask those answering Advertisements to be EXTREMELY ACCURATE with regard to the figures WHEN ADDRESSING REPLIES to Box Numbers.

EDUCATIONAL NOTICES.

Latest time for receiving, 9.30 a.m. Thursday.

SUCCESSFUL CORRESPONDENCE COACHING GUARANTEED for

A.M.I.E.E., A.M.I.C.E., A.M.I.M.E.,

City and Guilds Exams., Matriculation, B.Sc. (Eng.), etc.

Ten Years of Successes. —— Personal Enquiry Invited.

Up-to-date Courses to meet *your* particular needs in *any* branch of Electrical—D.C. or A.C., Civil or Mechanical Eng.

Special Courses in Practical Mathematics and Calculus.

ELASTIC PAYMENTS. STRICT PRIVACY. EXPERT ADVICE FREE.

A **"U.E.C."** COURSE will return you many times the outlay through the ADVANCEMENT SECURED professionally.

Apply *now* (saying what interests you) for the **"U.E.C." No. 7**

PROSPECTUS—FREE, to :—ADVISORY SECRETARY,

UNIVERSITY ENGINEERING COLLEGE, 3, St. Mark's Crescent, Regent's Park, London, N.W. 1—(No provincial branches.) 5297

UNIVERSITY OF LONDON, UNIVERSITY COLLEGE.

SESSION 1918-19.

FACULTY OF ENGINEERING.

The Session begins on Monday, September 30th.

DEGREE AND DIPLOMA COURSES.

STUDENTS desirous of entering the Faculty of Engineering with a view to taking a full Degree or Diploma Course must have passed the Matriculation Examination or some other examination accepted in its stead.

SPECIAL COURSES.

Students who have already undergone a partial training elsewhere, and who have attained a sufficient standard, may enter for a Course occupying less than three years, and may obtain a General Certificate of Engineering after not less than two consecutive sessions' attendance.

POST GRADUATE WORK AND RESEARCH.

Graduates in Science or Engineering, or Students who have done the work equivalent to a Degree, may be admitted to Special Courses of Study, or to prosecute original research.

ENTRANCE SCHOLARSHIP.

A Goldsmid Entrance Scholarship tenable in the Faculty of Engineering, value £90, will be competed for in September next. Application for Entry Forms must be made not later than SEPTEMBER 10th.

ADMISSION.

Intending Students should communicate with the PROVOST as soon as possible (and in any case not later than SEPTEMBER 14th), and should send a full statement of their previous training.

Full particulars may be obtained on application to the undersigned.

WALTER W. SETON, M.A., D.Lit., *Secretary.*

UNIVERSITY COLLEGE, LONDON
(Gower Street, W.C. 1). 2336

NORTHAMPTON POLYTECHNIC INSTITUTE, St. JOHN ST., LONDON, E.C.

Session 1918-19.

ENGINEERING DAY COLLEGE.

FULL DAY COURSES in the Theory and Practice of Civil, Mechanical and Electrical Engineering will commence on MONDAY, 30th SEPTEMBER, 1918. The Courses in Civil and Mechanical Engineering give a thorough grounding in Engineering work, and in the third and fourth years include specialization in various directions, such as Automobile and Aeronautical Engineering. In Electrical Engineering with similar grounding the specialization is in the direction either of Heavy Electrical Engineering or of Telegraphy and Telephony, including Radio-Telegraphy.

ENTRANCE EXAMINATIONS will be held on Tuesday and Wednesday, 24th and 25th September, at which Three Entrance Scholarships will be offered. The courses include two summer periods of about six months each spent in Commercial Workshops and extend over four years altogether. They also prepare for the Degree of B.Sc. in Engineering at the University of London. Fees for either of these courses, £15, or £11 per annum. *Students well grounded in Science, Mathematics and Drawing may be admitted direct to the second year's course.*

TECHNICAL OPTICS.

Full and part-time Courses in this important department of Applied Physics will be given in specially equipped Laboratories and Lecture Rooms. The entrance examinations will be held and the session will open on the dates given above.

An Aitchison Scholarship (value £30) will be offered in this department at the Entrance Examination.

Full particulars can be obtained on application at the office of the Polytechnic, or to— R. MULLINEUX WALMSLEY, D.Sc., *Principal.* 2296

CASTINGS

GUN-METAL · BRASS ETC

The LONDON ELECTRIC FIRM, CROYDON

PROMPT DELIVERY PHONE · PURLEY 68.

BASTIAN METERS

FOR DIRECT CURRENT ONLY.

Made in ENGLAND with BRITISH CAPITAL & BRITISH LABOUR.

Buy the cheapest and most efficient meter on the market from:

THE BASTIAN METER CO., Ltd.,

Bartholomew Works, Kentish Town, N.W.

"SISTOFLEX" (Regd.)

HIGH-GRADE

VULCANIZED FIBRE

in Sheets, Rods, Tubes, Valves, Washers, Discs, Stampings, &c., and Turnings of all kinds.

SPICER BROTHERS, LTD. 19, New Bridge Street, LONDON, E.C.

Telegrams: NYMOPTIC, LONDON. Telephone: CITY 6231 (6 lines).

Prices and Samples on application.

The COMMERCIAL ENGINEER'S POCKET BOOK.

ELECTRICITY SUPPLY.

A Handbook for Publicity Department Managers, Electricity Supply and Contractors' Representatives.

Price 2/- net. By FRANCIS H. DAVIES, A.M.I.E.E. Post Free 2/1.

H. ALABASTER, GATEHOUSE & KEMPE, 4, Ludgate Hill, London, E.C. 4.

The "ELECTRICAL REVIEW'S"

Suggestions for dealing with

APPARENT DEATH

from

ELECTRIC SHOCK

Can now be obtained

Reproduced on

GALVANISED IRON

PRICE ON APPLICATION.

HOME OFFICE SPECIAL RULES

For the Installation and Use of Electricity in Coal Mines.

The Home Office in its Rules issued relating to Electricity in Mines stipulates that "Instructions shall be posted up in every Generating, Transforming and Motor House, containing directions as to the restoration of persons suffering from electric shock."

H. ALABASTER GATEHOUSE & KEMPE,

4, Ludgate Hill, London, E.C. 4

The NEW Union Electric Co., Ltd.,

57, PARK STREET,

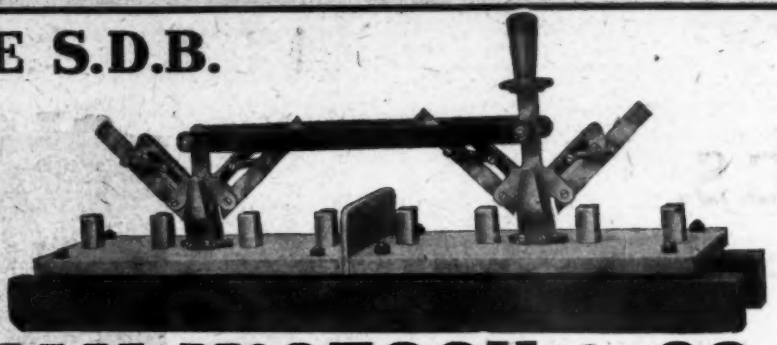
SOUTHWARK, S.E. 1.

ARC LAMP REPAIRS AND PARTS.

Telephone: Hop 2970. Tel. Address: "ABEAM, LONDON."

V TYPE S.D.B.

CHANGE-OVER SWITCHES.

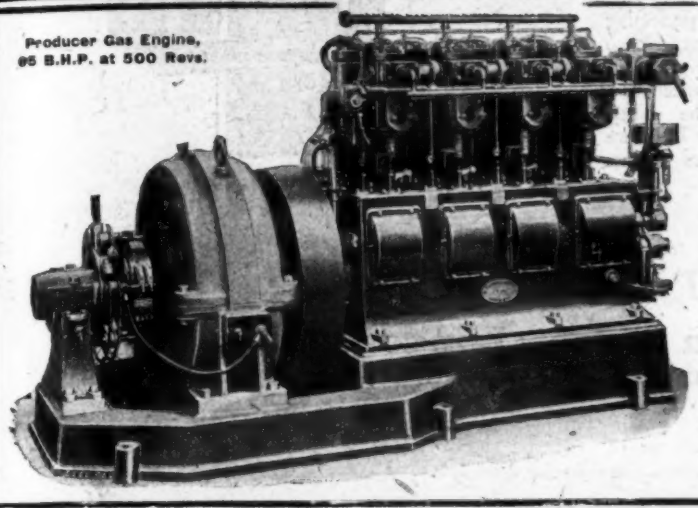


SUITABLE FOR CIRCUITS UP TO 500 VOLTS.

WILLIAM McGEOCH & CO., LTD.,

Electrical Engineers and Ships' Brassfounders,

28, West Campbell Street, GLASGOW. Warwick Works, BIRMINGHAM.



Producer Gas Engine, 65 B.H.P. at 500 Revs.

Telegraphic Address:—"THEOREM, PATRICROFT."

GARDNER

Gas and Oil Engines

Vertical High-Speed Type for coupling direct to Dynamos.

From 5 B.H.P. to 120 B.H.P.

L. GARDNER & SONS, Ltd.,
Barton Hill Engine Works,
PATRICROFT, MANCHESTER.

NORRIS, HENTY & GARDNER'S, Ltd.,
87, Queen Victoria Street, London, E.C.

Telephone No. 9702 City.
Telegraphic Address: NORNODESTE, CANNON, LONDON (charged as two words only).

Glasgow Showroom: 45, BOTHWELL ST.

ARMATURES REWOUND.

DYNAMOS AND MOTORS REPAIRED.

CONTRACTORS TO MUNITION WORKS, CORPORATIONS, INSURANCE COMPANIES, &c.

'Phone: 4109 Central.
Telegrams: Ohmic, Manchester.

AUSTIN WALTERS & SON, GAYTHORN, MANCHESTER.

60 Illustrations. Price 2s. 6d. net. Post Free 2s. 8d.

The Electrical Ignition of Petrol Engines

BY J. W. WARR, A.M.I.E.E.

An Invaluable Book for the Motorist and Motor Cyclist.

H. ALABASTER, GATEHOUSE & KEMPE, 4, Ludgate Hill, E.C. 4

THE

ELECTRIC TRAMCAR HAND-BOOK

FOR MOTORMEN, INSPECTORS, and DEPÔT WORKERS.

2/- NET.

POST FREE 2s. 2d.

BY W. A. AGNEW.

H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C. 4

ELECTRICAL REVIEW.

BINDINGS AND CASES.—Subscribers and others can have their half-yearly numbers bound handsomely in Black Cloth at the rate of 5/6 per Volume, including Index. Cases for binding are also supplied at 3/6 each, Indices 3d. each.

Well-Finished Brass Stand

READING LAMP

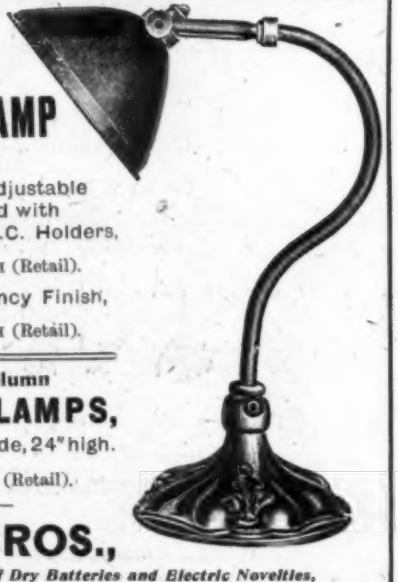
(16½" HIGH),

Nickelled Brass Adjustable Reflector, fitted with B.C. or S.B.C. Holders,

26/6 EACH (Retail).

Ditto, assorted Fancy Finish,

29/6 EACH (Retail).



Pedestal Column

READING LAMPS,

with Carrier for Shade, 24" high.

35/- EACH (Retail).

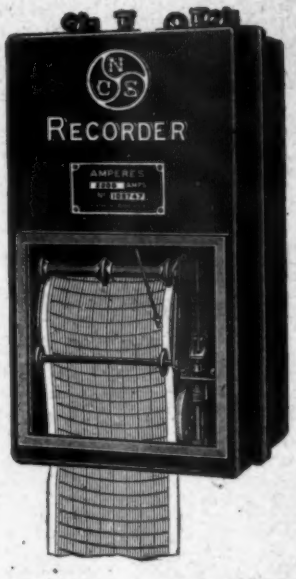
ROSE BROS.,

Manufacturers of Dry Batteries and Electric Novelties,

25/27, Milton Street, LONDON, E.C. 2 & 194a, St. Vincent St., GLASGOW.

Telephones:—LONDON: Central 7042-3. GLASGOW: Central 5120.

N.C.S.
Recording Instruments.



Dead Beat Moving Coil Instrument for continuous current only. Fitted with oil damper. Easy access for re-charting. The clock has a well-made 8-day lever movement of our own manufacture, and is capable of accurate regulation.

We have spent 33 years in perfecting N.C.S. Instruments. Actual experience and experimental work have produced a standard of unsurpassed excellence. N.C.S. Instruments can be relied upon for extreme accuracy. They are pre-eminent in Quality and Value.

NALDER BROS. & THOMPSON, Ltd.,
97a, Dalston Lane, London, E. 8.

Telegrams: "OCCLUDE KINLAND LONDON." Telephone: DALSTON 2365 and 2366.

Tricity TRADE MARK REGISTERED

Tricity TRADE MARK REGISTERED

Flamingo

ELECTRIC FIRES.

"Full of Life and Distinction."
"Flame like a Coal Fire at its Best."

UNRIVALLED ATTRACTION.

WRITE FOR PARTICULARS.

Manufacturers and Patentees:
The BRITISH ELECTRIC TRANSFORMER CO., LTD.,
HAYES, MIDDLESEX.
'Phones: EALING 226 & SOUTHALL 101

Sole Wholesale Agents:
Messrs. GILLESPIE & BEALES,
Amberley House,
NORFOLK ST., STRAND, W.C.
'Phone: GERRARD 2681.

DISPLAYED ADVERTISEMENTS

ADVERTISERS will please note that **NEW COPY and ALTERATIONS** to Existing Advertisements (with Blocks) should reach here not later than **SATURDAY MORNING.**

The ELECTRICAL REVIEW is the recognised Medium of the Electrical Trades, and has BY FAR THE LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

OFFICIAL NOTICES.

Latest time for receiving 9.30 a.m. Thursday.

PLYMOUTH CORPORATION.

THE PLYMOUTH CORPORATION invite Tenders for a 500-KW., 500/550-volt, D.C. Generator, direct-coupled to a triple-expansion engine, which they have for disposal.

Particulars and form of tender can be obtained from the undersigned on application before AUGUST 24th, 1918.

E. G. OKELL,
Borough Electrical Engineer.

Electricity Works,
Prince Rock,
Plymouth. 2324

NOTICES RELATING TO PATENTS.

Latest time for receiving 9.30 a.m. Thursday.

John E. Raworth,

Queen Anne's Chambers, 28, The Broadway, Westminster, S.W.1. **Chartered Patent Agent.**

PATENTS ACT, 1907 (Section 27).

THE Proprietors of British Patent No. 18711, of 1914, for "Improvements in and Relating to Wireless Telegraphy," desire to grant Manufacturing Licences, or to make other arrangements on reasonable terms, for the purpose of working the invention in this country.

For full particulars apply—

MATHYS & CO.,
Chartered Patent Agents,
52, Chancery Lane, W.C.2. 2332

ELECTRICAL REVIEW.

BINDINGS AND CASES.—Subscribers and others can have their half-yearly numbers bound handsomely in Black Cloth at the rate of 5/6 per Volume, including Index. Cases for binding are also supplied at 3/6 each, Indices 3d. each.

F. WIGGINS & SONS.

MICA

Telephone: Avenue 2248

FOR INSULATION.

Largest Stock in the World.

102, 103 & 104, Minories, LONDON, E.1.

DUGDELL'S PATENT MOVABLE FITTINGS.

Fig. 225

HUNDREDS OF PATTERNS.

Thousands of Repeat Orders.

See Full Page Second Issue of "Electrical Review" each month.

CATALOGUE ON APPLICATION.

FAILSWORTH, MANCHESTER.

Cloth, 2s. 6d. Post Free, 2s. 8d.

THE ELECTRICAL IGNITION OF PETROL ENGINES.

BY

J. W. WARR, A.M.I.E.E.

With Sixty Illustrations.

H. ALABASTER, GATEHOUSE & KEMPE,
4, Ludgate Hill, London, E.C.4.

PROMPT DELIVERY.

SILUMINITE.

PROMPT DELIVERY.

Top Cap for D. F. Wireless Mast.
MADE OF SILUMINITE.

THE NEW **BRITISH** INSULATING MATERIAL,
as used by the Government and leading Electrical Firms and Railways.

Fireproof. Non-Hygroscopic. High Electrical Resistance.

WITHSTANDS HEAT, ATMOSPHERE, HOT TRANSFORMER OIL, ALKALIES, OZONE, WATER, &c.

Rich black colour, and readily polishes.

HIGH ELECTRICAL RESISTANCE
13,000 Volts per Millimeter.
Does not soften under any heat.

Moulded readily during manufacture into any shape.
Moulded on iron pins and into caps, etc.
Can be applied to metal parts.

LOW IN PRICE.

DOES NOT SOFTEN OR WARP.

SHEET
FROM
6d. PER LB.

Replaces Glass, China, Slate, Marble, Fibre, &c.
TURNS, TAPS AND DRILLS.

THE SILUMINITE INSULATOR CO., LTD.,

Telephone: SOUTHALL, 59. **The Green, Southall, Middlesex.** *Telegrams: "SOUTHALL, 59."*

"Paramho"

WIRES & CABLES

for Lighting

"Paramho" Flexibles are unequalled for reliability.

for Heating

"Paramho" Vacuum Cleaner Cord is ideal for heating apparatus.

for Power

"Paramho" Cables are unsurpassed for service.

for Bells

"Paramho" Wires are best quality wires.

"Paramho" Wires and Cables are the product of extensive manufacturing experience. They are made in accordance with the C.M.A. formulæ, are supplied in several grades to suit varying conditions of service, and are offered with every confidence for use in high-class installations.

The British Thomson-Houston Co., Ltd.,

Mazda House, 77, Upper Thames Street, E.C. 4.
Works: Rugby. Branches in all Large Towns.

E. 18.

Telephone: Museum 333.

TREDEGARS, Ltd.,

WHOLESALE AND EXPORT ELECTRICAL SUPPLIES,

9, Diana Place, Euston Road, N.W. 1,

Also at 47, Exchange Buildings, Birmingham.

We are holding a good stock of English Holders, cord grip, also ½" and ⅝" shade carrier Holders, Flexibles and Cables.

DYNAMOS AND MOTORS.

PROMPT DELIVERY against Ministry of Munition Certificates.

WRITE FOR PRICES AND PARTICULARS.

CROWTHER & OSBORN, Ltd.,

7, Blackfriars Street, Salford, MANCHESTER.

London: MURPHY STEDMAN & CO., Ltd., 180, Gray's Inn Road, London, W.C.1.

Paris: 40. Rue Blanche.

EXTRUDED ROD WORK

Up to 1" DIAMETER.

STEEL CONDUITS

and FITTINGS.

STEEL TUBES & CONDUITS CO.,
KEIGHLEY.
'Phone: 260.

EXHAUST

FANS

S·G·LEACH
& Co LTD.
26–30 ARTILLERY LANE.
LONDON. E.C. 2.

Controlled

That word has assumed a new meaning in our War experience and, to the firm with an organization capable of producing munitions or other Government requirements, usually implies the complete cessation of normal business.

That is our position to-day, and every machine, every tool, every worker is engaged on the fulfilment of the National purpose, *but*—

That position will pass and, in the interests of British Manufacture, we desire, even at this period, to discuss the question of the mass production of Repetition parts for which our greatly widened facilities are particularly suitable.

With this object we invite correspondence with bulk buyers, who desire, with us, to make real preparation for Post-War Trade.

SUCKLING

W. SUCKLING & SONS

1, KINGSWAY HOUSE,
Albion St., BIRMINGHAM.

LONDON: Morley House,
Holborn Viaduct, E.C. 1.

1233

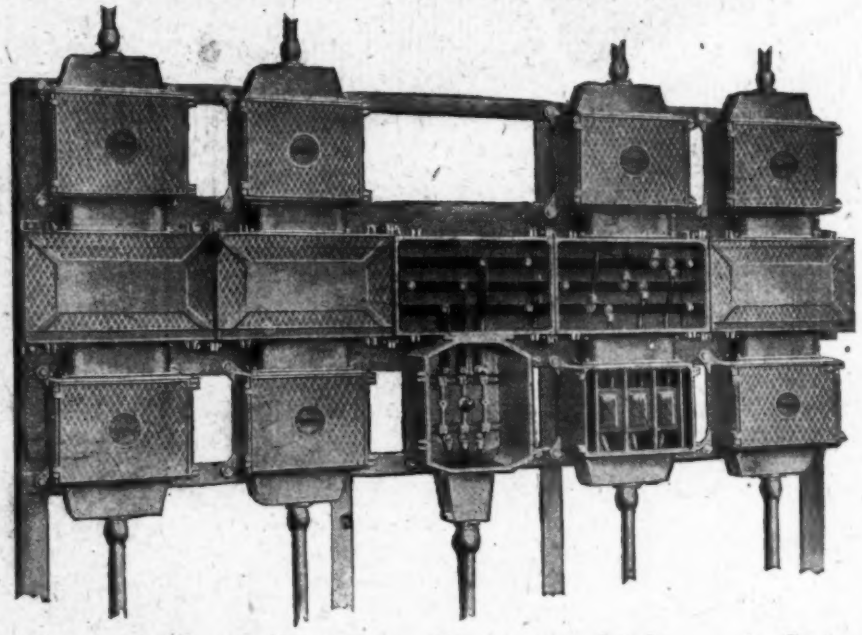
HOPE'S PATENT

Fluvent

REGD. TRADE MARK

UNIT BOARDS

provide an arrangement of "FLUVENT" Fuses only where Switches are not required—



or, alternatively, ordinary handle fuses, whichever is desired.

MICA, STEEL & CHINA *only*

are employed to build these totally-enclosed, ironclad, power-centre boards, which will stand up to the severest conditions.

Extra units can be added at any time by merely detaching the end covers, and extra bus-bar sections can also be added, without fitting.

The FLUVENT Fuses used in the Board illustrated have been proved to be absolutely ideal for large power consumers. The Board itself is one of a large number which have been supplied to the Admiralty.

Full FLUVENT Fuse advantages described in our Catalogue.

PARMITER, HOPE & SUGDEN, LTD.,
Hulme Electrical Works, MANCHESTER.

London Office: 25, Victoria Street, S.W. 1. Scotland: David Alexander, Mains St., Waterloo St., Glasgow.
Birmingham & Midlands: S. Thos. Pemberton & Co., 7, Church St., Colmore Row, Birmingham.

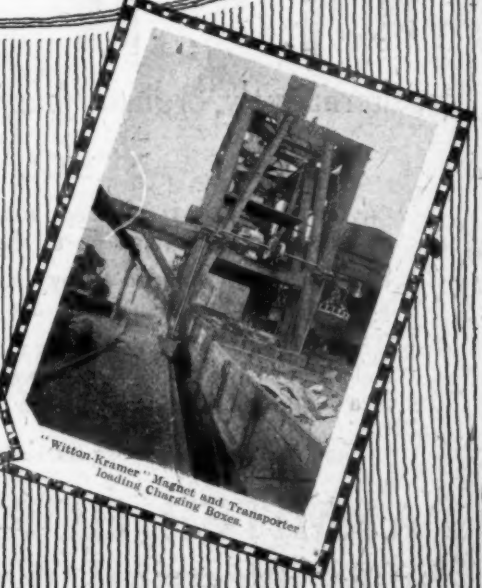
G.E.C.

"Witton-Kramer" Magnet Jib Crane handling material in Stock Yard.

56-in. "Witton-Kramer" Magnet loading Charging Boxes.

56-in. "Witton-Kramer" Magnet unloading scrap and pig.

56-in. "Witton-Kramer" Magnet loading Charging Boxes with scrap.



"Witton-Kramer" Magnet and Transporter loading Charging Boxes.

REGISTERED TRADE MARK

G.E.C.

Industrial Electrification.

No. 15.—TRANSPORTATION OF STEEL WORKS MATERIALS.

THE adoption of the "Witton-Kramer" lifting Magnet has effectively contributed to a solution of the man-power problem during the war, and economies in money and labour have been achieved which would have exceeded the credible before the actual installation of the magnet.

Capital outlay has been saved by the elimination of the shunting locomotives and a reduction in the extent of the railway sidings.

Running charges have been reduced by bringing truck demurrage costs to a minimum amount and by eliminating practically the whole of the labour usually required for discharging the trucks, with the mere addition of a crane driver.

Works costs have been reduced by enabling the furnaces to be fed without intermission, obviating waits through shortage of raw material at the charging boxes.

"Witton-Kramer" Magnets have completely solved the problem of handling scrap iron, steel ingots, crop ends, and so forth, either into the charging boxes or into the stock yard.

"Witton-Kramer" steam jib cranes, either new or converted existing cranes, have proved of great value about the yard.

"Witton-Kramer" Transporters have been designed specially to overcome difficulties met in particular works in handling the raw materials in the stock yards and at the charging boxes.

The Witton-Kramer Company are now laying down installations solving the difficulties previously experienced in the handling of plates and bars and the new "1918" pattern "Witton-Kramer" rectangular magnet has proved highly successful in this direction.

The latest "Witton-Kramer" contracts include the handling of armour and other plates at the rolling mill by Skid Magnets on a novel principle.

The experience of the Industrial Electrical Engineers of the "Witton-Kramer" Tool & Hoist Works, of whom the General Electric Co. are the proprietors and sole selling agents, is at the disposal of steel works' engineers and managers, and of supply authorities having steel works within their supply area, and they are invited to consult the Company regarding any materials handling schemes contemplated either immediately or in the future.

Next Week - - BRIGHT STEEL BAR WORKS.

The General Electric Company, Ltd.,

Head Office: Queen Victoria Street, London, E.C. 4.

Telephones: London Wall No. 3600 (30 lines). *Telegrams:* "Electricity Cent, London."

BRANCHES—

Manchester—Victoria Bridge.
Liverpool—Church Alley.
Leeds—Wellington Street.
Sheffield—Angel Street.
Glasgow—Waterloo Street.
Cardiff—Womanby Street.
Bristol—Victoria Street.
Swansea—Wind Street.
Newcastle-on-Tyne—Gallowgate.
Hull—Charlotte Street.
Ipswich—Princes Street.
Southampton—High Street
Aberdeen—Bridge Street.
Birmingham—High Street.
Nottingham—Chapel Bar.
Belfast—Queen Street
Dublin—Trinity Street.
Cork—Grand Parade.

REGISTERED TRADE MARK

Quiet Operation—

Equipments driven by

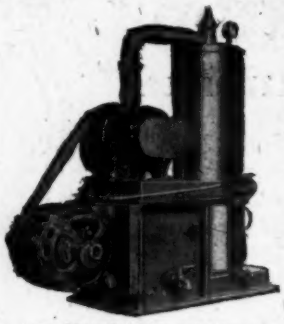
Century

REPULSION START—INDUCTION

SINGLE-PHASE MOTORS

easily meet the specifications covering apparatus for installation in public buildings, churches, schools and residences.

—when full speed is reached the brushes are removed from the commutator.



1 H.P. Motor belted to a stationary vacuum cleaner.

1/10 to 40 H.P.

25 to 140 Cycles.

Manufactured only by

CENTURY ELECTRIC COMPANY,

19th Pine to Olive Streets, St. Louis, Mo., U.S.A.

A STOCK OF "CENTURY" MOTORS IS CARRIED IN LONDON BY—

The Sole British Agents—

SWEDISH GENERAL ELECTRIC, LTD.,

5, CHANCERY LANE, W.C. 2.

Sales Manager: R. A. MARPLES.

Telegrams: "Autosyncro, Westcent, London." Telephone: Holborn 1703.

560

ACTUAL MANUFACTURERS.

TAPES, WEBS, SLEEVINGS,

For all classes of Electrical Work.

Large Stocks kept.

Samples by return on application.

JAMES NORTH HARDY & SON, LTD.,

54, Portland Street, MANCHESTER.

Telegrams: "Hardson, Manchester." Telephone: 6471 Central.

LONDON: 3, Fitchett's Court, Noble Street, E.C.

GLASGOW: 76, Virginia St. BELFAST: 29, Franklin St.

REWINDING AND REPAIRS

OF

MOTORS AND DYNAMOS,

FANS,

RHEOSTATS, &c.

VACUUM CLEANERS.

ALTERNATING AND DIRECT CURRENT.

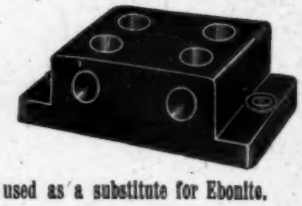
MAGIC APPLIANCES, LTD., 159, Westminster Bridge Road, LONDON, S.E.1.

Telegrams: "Magicapco, Lamb, London." Telephone: Hop 4703.

SEND US YOUR ENQUIRIES

FOR

MOULDED INSULATING ARTICLES.



Our composition can be used as a substitute for Ebonite.

THE IMPROVED SOLIDITE CO., LD.,

10, CHARLTON PLACE,

Opposite Agricultural Hall,

ISLINGTON, N. 1.

Telephone: NORTH 1345.

DIMALITE

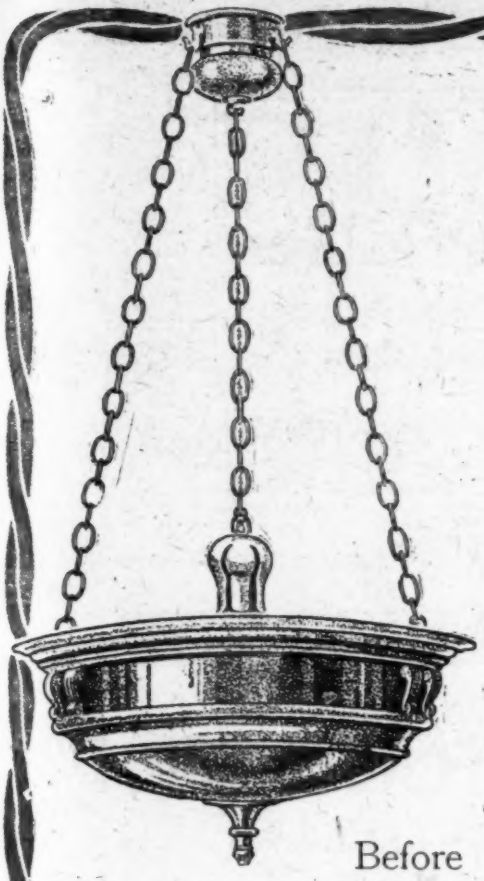
THE ONLY SUCCESSFUL "TURN-DOWN" ATTACHMENT FOR ELECTRIC LIGHT.

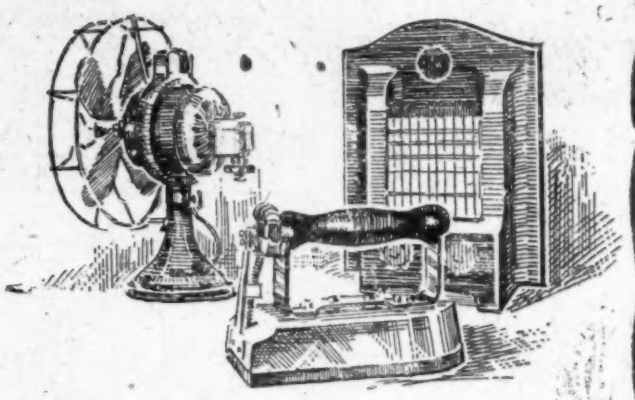
PAGE & SEYMOUR LTD. 6, CHURCH ST., NEW YORK, U.S.A.

5 DIFFERENT CHANGES OF LIGHT!

SUPPLIED IN TWO TYPES: LOW VOLTAGE (80 to 130 V.) and HIGH VOLTAGE (200 to 250 V.).

BENJAMIN ELECTRIC, LTD., Brantwood Works, Tariff Road, Northumberland Park, Tottenham, N.17.





Save him the current for other electrical uses—

Before a consumer extends his use of electrical apparatus by installing say, a cooker, a fan or a fire, he invariably asks himself "Can I afford the current?"

If his lamps are helping to save the current that will be used to run these additional appliances, he will be inclined to entertain suggestions for developments.

It will pay you as well as your client to instal the lamps that save current.

IF your client is using Standard Type Drawn Wire Lamps, tell him that a Mazda Half-Watt Lamp will give him MORE light than he had before and take LESS CURRENT.

MAZDA
HALF-WATT TYPE
Electric Lamps

The British Thomson-Houston Co., Ltd.,
Mazda House, 77, Upper Thames St., London, E.C. 4.

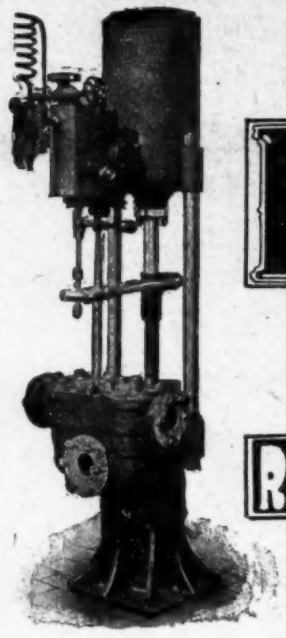
E 100

Mazda House is the Home of Reliable Wiring Accessories.

Send us your enquiries for everything electrical you require.

If it's electrical get it from B T-H

We are Specialists in Good Lighting. We design and make Scientific Lighting Appliances and Fittings as well as the Lamps. Lighting Advice and Plans on request.



HALL'S PUMPS

Boiler Feed

Single & Compound

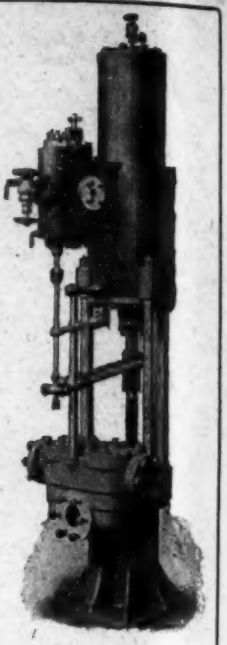
The Great Success of the Hall Pump

IS DUE TO ITS

RELIABILITY! SIMPLICITY! ECONOMY!

J.P. HALL & SONS LTD.

PETERBOROUGH



Tel. Address: "Clifford, Birmingham." Established 1776.

TRADE MARK.

CHARLES CLIFFORD & SON, LTD.

BIRMINGHAM.

Contractors to the Principal Railway Companies.

PHOSPHOR BRONZE and GUN METAL

in Castings, Sheets, Tubes, Rods, Wire.

PHOSPHOR TIN and PHOSPHOR COPPER, MANGANESE BRONZE.

BRASS CONDENSER TUBES

for Standard Ships, etc.

We supply EVERYTHING FOR THE

DRY BATTERY TRADE

The HILLBAR PRESS,

76, FINSBURY PAVEMENT, E.C.2.

TEL:- "LONDON WALL, 6794" Works:- EASTHAM.

The "ALPHA" CABLE CONNECTOR.

NO SWEATING.

MADE IN ALL TYPES & SIZES.

SOLE SELLING AGENTS:

HASLAM & STRETTON, LTD.

TELEGRAMS 11 WINDSOR PLACE 'THOR CARDIFF'

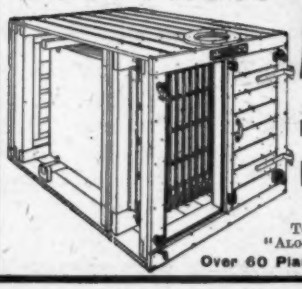
CARDIFF

Each pocket easily and separately removable.

Working at a very low resistance.

DUST-PROOF

AIR FILTERS



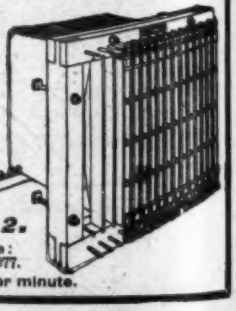
WITH SINGLE POCKETS. Patent No. 9845/11.

For VENTILATION, for GERMS, & for TURBO-GENERATORS, &c.

FILM COOLING TOWERS, Ltd.,

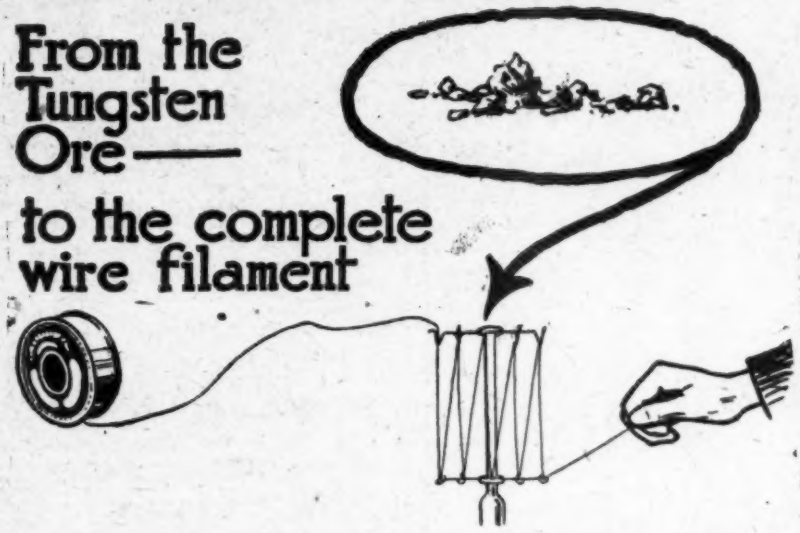
124, Chancery Lane, London, W.C. 2.

Telegrams: "ALOOF, LONDON." Works: MIDDLESBROUGH. Telephone: HOLBORN 5877.



Over 60 Plants installed for Filtering 1,500,000 cubic feet of air per minute.

From the Tungsten Ore—



to the complete wire filament

Process by process the work is carried out by British labour in our London Works. We do not buy the Tungsten Powder or the Tungsten Rod.

We begin with the Ore, refine and reduce it, work it into rod, swage it down, and finally draw down into the finest filaments.

We are Tungsten and Molybdenum experts.

See that your lamps are made with

"Pladuram" Wire

which is the only sure guarantee of a British product from start to finish.

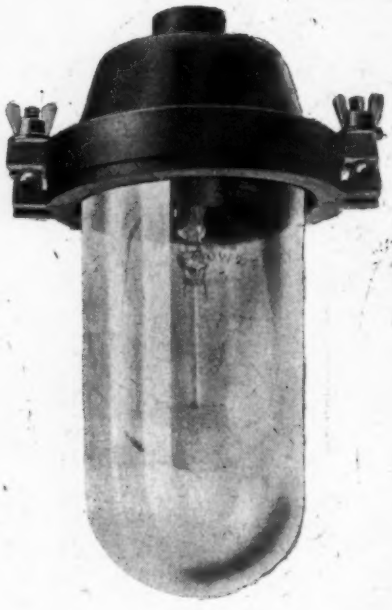
Duram Ltd

Thanet House,
231-2, Strand, London, W.C. 2.

SIMPLEX

Deep Water-Tight Lanterns

Tapped to receive ¾" down drop or bracket arm.



The new pattern illustrated is cast with a deep recess in the top into which the lampholder goes.

The deep cast body and standard well glass make a pleasing well-balanced combination and avoids the necessity of stocking extra deep well glasses.

Write for Mailing Card No. 676.

Simplex Conduits, Ltd.,

Works : Garrison Lane, Birmingham.

113-117 Charing Cross Road, London, W.C.
16 Corporation Street, Manchester.
72a Waterloo Street, Glasgow.
61 High Bridge, Newcastle.
11 Denmark Street, Bristol.
96 Whitechapel, Liverpool.
6 White Horse Street, Leeds.
281-3 Attercliffe Common, Sheffield.
14 Heathfield Street, Swansea.
4 Westgate Street, Cardiff.
1 Crimon Place, Aberdeen.

RALPH NEAL,
Maker of Presses, Press Tools & Punches
Of Every Description for Electrical and Mechanical Engineers. BLANKS, WASHERS, PRESS PIERCINGS, DIE STAMPINGS IN STEEL, BRASS OR ANY MATERIAL FOR THE TRADE.
LABELS and NAME PLATES A SPECIALITY.
49 & 50, PERCIVAL ST., LONDON, E.C.1
Telephone: 4948 Central.

NAME PLATES
ENGRAVED CAST PRESSED PRINTED
BRASS COPPER ALUMINIUM IVORINE CELLULOID
LONDON LABEL Co LTD
HARLEY WORKS, BECKTON Rd E.

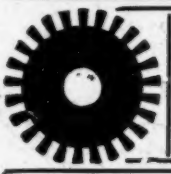
The Croft Granite, Brick & Concrete Co., Ltd.,
CROFT, near LEICESTER.
CROFT ADAMANT CELLWORK FOR E.H.T. EQUIPMENT.

URGENT REWINDING,
REPAIRS & RENEWALS.
Send to—
ELLERD-STYLES, 81, ROSEBERY AVENUE, E.C. 1.
'Phone: 1440, Central.

SWITCHBOARDS.
Westwood Mfg. Co., Empire Works, Shepherd's Bush, London, W. 12.

PURE ACIDS
FOR
ELECTRICAL PURPOSES.
Write— THOMAS JACKSON (CLAYTON), LTD.,
MANCHESTER.

"HOBSIL" INSULATING BRICKS
Give Highest Efficiency for
ELECTRIC FURNACES, OVENS, &c., &c.
HOBDELL, WAY & CO., Ltd., 124/7, Minories, LONDON, E. 1.
Telephone Avenue 3510



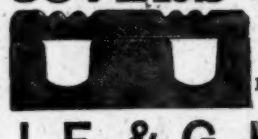
Armature, Dynamo and Transformer Stampings, Plain and Slotted—to customer's drawings or prints. Dynamo and Transformer Sheets, Swedish Iron Rods and Bars, black and bright drawn.
TURNER BROS., 134, Upper Thames St., E.C.
Telegrams: "Sheetiron, London." Telephone: 555 Central.

RIGHT AT THE FRONT.
The **"ADAPTABLE"** Earthing and Bonding Clip.
Absolutely the only Clip on the market that will fit any size Conduit, Cable, or Pipe.
Tel. 5630 City.

HANN & INGLE, 13, Albert Place, Bridge Street, Manchester. (Or your Supplier.

TELEPHONES
PATENT LOUD SPEAKING WATER-TIGHT.
ALFD GRAHAM & Co., CROFTON PARK, S.E.
ADOPTED BY MANY FOREIGN GOVERNMENTS AND THE LEADING STEAMSHIP LINES.
FOR SHIPS, MINES, POWER STATIONS, etc.

COVERS & CASINGS.



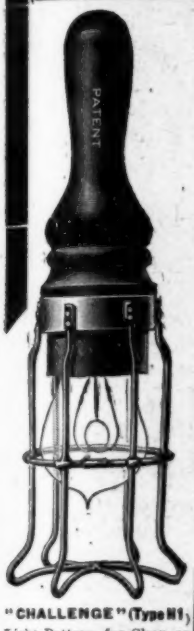
BLOCKS. CLEATS.
BOARDS FOR SWITCHES in Stock and made to any Design
ACCUMULATOR CASES and BATTERY BOXES Made to Order.
Please write for Latest Illustrated Price List.

J. F. & G. HARRIS, LTD.,
TIMBER MERCHANTS AND MOULDING MANUFACTURERS.
SAWING, PLANING, MOULDING & GENERAL WOODWORKING MILLS—
58a, WILSON STREET, FINSBURY, LONDON, E.C. 2
Telephone: No. 1188 London Wall. Telegrams: "Pandecors, Finsquare, London."

"GUARDIAN" PATENT HAND LAMPS.

SAFETY HAND LAMPS to comply with HOME OFFICE REGULATIONS.

Adopted by the leading Engineering Firms, Shipyards, Corporations and Government Departments. A feature of these Hand Lamps is that there are no screws fixed in a horizontal position. The supporting strap on the "Guardian" Lamps is held by fibre pegs, and bound by soldered non-rusting tinned wire.



"CHALLENGE" (Type H1). Light Pattern for Shop or House use. Complete with Guard and Lamp Holder. PRICE 5/- each.

"GUARDIAN" (Type G1). complete with heavy Guard and Lamp Holder. PRICE 8/- each.

The safest and best flexible cord to use with these Hand Lamps is our T.R.S. Cord, which is protected with tough rubber and is shock proof.

"GUARDIAN" (Type G4). Hand Lamp, complete with Special Luminised Steel Reflector, 7 in. diam. and Lamp-holder. PRICE 10/6 each.

The "DREADNOUGHT" Fitted with hinged Guard to which a lead seal can easily be attached. With cord grip attachment and Lamp Holder. PRICE 8/- each.

Telegrams: "Multum," Manchester. Telephones: 7083-4-5-6, Central.

ADVANCE TUBE CARRIERS.

We hold immense stocks for immediate delivery.

Sizes stocked to hold conduit.

⅜	½	¾	1	1¼	1½	2" dia.
16	19	22	25	32	38	50 m/m
3/2	3/2	4/2	4/2	5/9	7/4	9/- doz.

"INDISPENSO" CHINA CONNECTORS.

BRITISH MADE

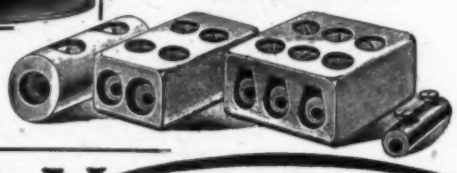
We have designed the "INDISPENSO" CHINA CONNECTOR for positions where very small space is at disposal. Takes up to 7/20 cable.

No Metal Projecting Parts. Ensures Good Joints.

ONE WAY,	TWO WAYS,	THREE WAYS,
2/6 Doz.	3/6 Doz.	5/6 Doz.

PRICES FOR LARGER QUANTITIES ON APPLICATION.

Made in eight different sizes.



Ward & Goldstone SALFORD MANCHESTER

CANNING'S "AJAX" ELECTRO-ZINCING

(COLD GALVANIZING)

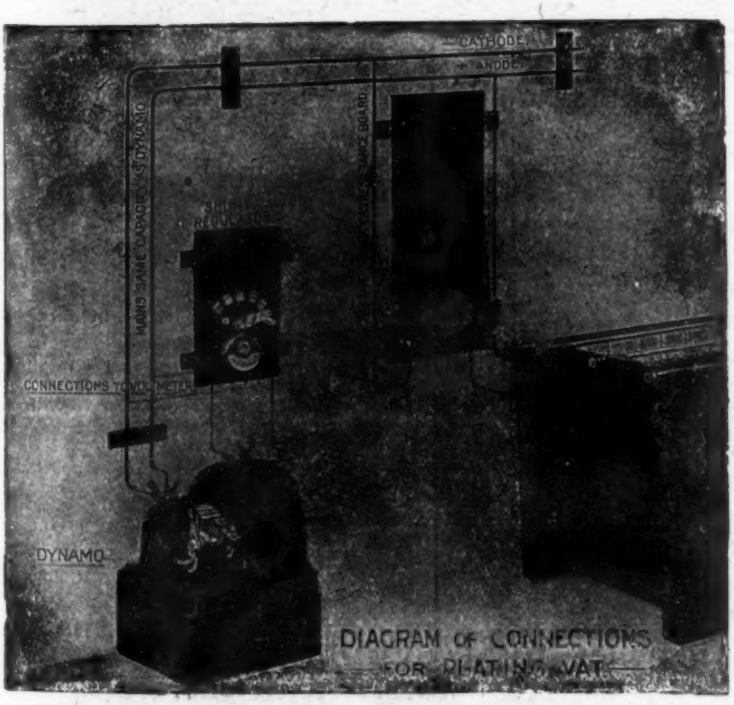
SOLUTION

FOR

MUNITIONS,
BOILER TUBES,
MARINE WORK,
WATER FITTINGS.

GIVES A SMOOTH PROTECTIVE COAT.

ESTIMATES FOR COMPLETE PLANT ON APPLICATION.



Write for List E.Z. to

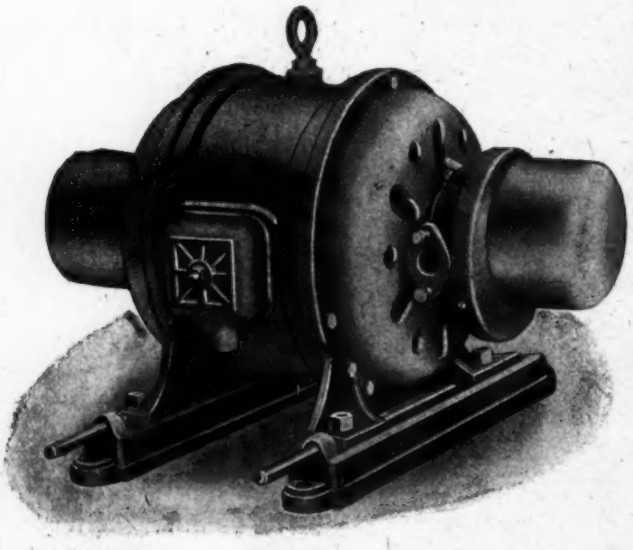
W. CANNING & Co *Electro-Platers' Engineers,* **BIRMINGHAM** (England).

TWO FAMOUS BROOKS

Ye Brooke of Tennyson ~

which goes on and on for ever and hath a world-wide reputation—

and



E. BROOK, Ltd.

of

Huddersfield,

The Makers of the Motors with the world-wide reputation. . .

J. P. HALL & Co., LTD.
OLDHAM.

Telegrams: "DYNAMO," OLDHAM.
Telephone: 300 (two lines).

MOTORS AND DYNAMOS

FOR

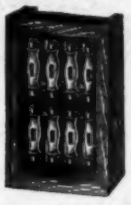
Direct or Alternating Current.

Fig. No. 378.

50-H.P. D.C. MOTOR WITH BEDPLATE AND OUTER BEARING.

No. 642.

10 sizes. No. 640.



No. 132.

No. 225. 5 sizes.

500-volt H.O. Fuseboard. No. 311. SHOCK-PROOF.

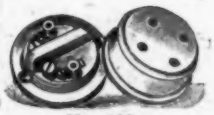
No. 621.

No. 36 A. 12 sizes.

No. 16. 20 sizes.

No. 109.

No. 700. One and two-way.



No. 102. In 5 and 10-amp. sizes.

No. 662.

No. 103. Pulleys take $\frac{1}{16}$" dia. Cord.

No. 1. **Large Connector.** Also two and three ways.

No. 14. **Connector.** Also one-way and two-way.

E.I. Shades. 8" to 18" dia.

Tapes. India-Rubber and Black Adhesive.

No. 111. **Ship Type.** Small and compact.

No. 775. **Wood Battery Boxes.** 2 or 3, or 4-cell.

P 125.

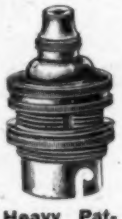
P 145. **Copper Earthing Clips.** ½ in. to 2 in. 8 sizes.

F. RYMAN,

116, Livery St., BIRMINGHAM.

Tel.: CENTRAL 4358.

Prompt Delivery of Class "A" Orders.



Heavy Pattern English Holders.

Flexibles.

No. 780. **Flush Switch Boxes.**

"Ironclad Exide"

(Registered)

THE BATTERY FOR COMMERCIAL ELECTRIC VEHICLES.

SUPPLIED TO ALL THE LEADING RAILWAY COMPANIES.

The collection and delivery of goods from a central depot to the surrounding neighbourhood—short haul, frequent stops—is a class of work in which the electric vehicle can show more favourable results than any other form of traction, animal or mechanical.

Send for Circular 40, describing the Cell in detail.

THE Chloride ELECTRICAL STORAGE CO. LIMITED

CLIFTON JUNCTION, MANCHESTER.

LONDON OFFICE: 39, VICTORIA STREET.

Printed by WILLIAM CATE, LTD., 47-150, Saffron Hill, E.C. 1, and Published by the Proprietors, H. ALABASTER, GATESCUSE & KEMPE, 4, Ludgate Hill, London, E.C. 4.

Catalogues and Lists.—The Davis Furnace Co., Diamond Foundry, Luton.—Circular DO/18, dealing with drying stoves for core drying, japanning, enamelling, armature drying, &c., and quoting current prices, weights, &c.

Dictograph Telephones, Ltd., 7, Southwark Street, S.E. 1.—"Multiplying Efficiency," a pamphlet describing the Dictograph Interconversing system, which saves time and facilitates control, with the aid of a loud-speaking receiver and a very sensitive transmitter at the master station, and automatic communication with ordinary stations. Practically, the system brings the heads of departments instantly into the presence of the chief, who can talk to them and hear their answers as if they were sitting round his table, without holding a receiver or approaching the transmitter.

Book Notices.—*Selwyn's Metric Conversion Tables.* Edited by W. E. Dommett. London: James Selwyn & Co., Ltd. Price 2s. 6d. net.—This is an entirely new work, designed to meet the requirements of men engaged in various branches of engineering and science. In his introductory notes the editor makes a slip when he states that "the complete metric system is at times known as the c.g.s. system"; the latter is an off-shoot of the former, and forms the basis of the systems of units used in physics and electrical engineering. The metric system is based upon the metre and kilogram, and takes no account of time at all. The tables are of a very useful character, covering a wide range of requirements met with in practical work, and including a number of compound measures; they are clearly set out for ready reference, and our only criticism is directed to the old question of significant figures. Equivalents of millimetres in inches are carried to thousandths of an inch, and in the converse sense to hundredths of a millimetre, to which we raise no objection; feet and inches are expressed to single millimetres, of which also we approve. But the equivalents of metres (1 to 100) in feet are carried to six figures, and *vice versâ*, and many other tables are similarly meticulous in their supposed accuracy—we say "supposed," because the assumption is that if 73 lb. = 33·11229 kg., the former is known to be correct to at least 5 or 6 significant figures; in practice, however, it is not likely to be known more accurately than 3 or 4 figures would imply, and all ordinary requirements would be met if the value of 73 lb. were given as 33·11 kg. These useless strings of decimals in tables constitute one of the most serious obstacles to the adoption of the metric system, although the objection is based upon ignorance of practical physics and mensuration. Those who know what they are doing, of course, use only as many figures as they require; but the average clerk would laboriously fumble with the whole string of 6 or 7 figures—and curse the metric system!

If the authors of such tables would either preserve a sense of proportion in their equivalents, or use small type or italics for the ultra-accurate figures, pointing out that the latter need not be used except when extreme accuracy was essential, our criticism would be met. Thus we might have—

$$73 \text{ lb.} = 33{\cdot}11_{229} \text{ kg.}$$

In general, the equivalent need not be stated to more than four significant figures for practical purposes; the error cannot then exceed one part in 2,000, and the average error will be less than one in 10,000. Subject to this criticism, the tables appear to us to be admirably chosen and well arranged.

"The New Moon: a Romance of Reconstruction." By Oliver Onions. London: Hodder & Stoughton. Price 6s. net.

The Twelfth Annual Report of the British Science Guild can now be obtained (price 1s.) on application to the Secretary, British Science Guild, 199, Piccadilly, W.1. The Report contains addresses by Lord Sydenham, Sir Henry Newbolt, and Sir Algernon Firth, delivered at the recent annual meeting of the Guild, together with particulars of the British Scientific Products Exhibition, and Memoranda on the British Dye Industry, the Introduction of the Metric System, Scholarships for Higher Education, the Teaching of Science, &c.

"The Education Act, 1918, Summarised and Explained." London: National Education Association. Price 6d.

"Tests of Large Bridge Columns." By J. H. Griffith and J. G. Bragg. "Ground Connections for Electrical Systems." By O. S. Peters. (Technologic Papers of the Bureau of Standards.) Washington: Government Printing Office. Price 30 cents. each.

"National Physical Laboratory: Report for 1917—18." London: H.M. Stationery Office. Price 2s. 6d. net.

"List of Electrical Undertakings in India." Compiled in the office of the Electrical Adviser to the Government of India. Calcutta: Superintendent Government Printing, India. Price Rs. 4, or 6s.

Liquidations.—Richard Hornsby & Sons.—Winding up voluntarily. Mr. W. Haynes (secretary to the company) and Mr. R. Smith (of Lincoln), liquidators. Meeting of creditors August 26th, at 75B, Queen Victoria Street, E.C.

Woods-Gilbert (British) Rail Grinding and Milling Co., Ltd.—Winding up voluntarily. Mr. J. Cameron Kelvin, Bridgefield Road, Sutton, and Mr. A. G. Conway, 170, Strand, W.C., liquidators.

Patents and Alien Enemies.—The Board of Trade has granted the application of Messrs. J. S. Highfield, A. A. C. Swinton, and P. D. Tuckett, for licences in connection with 34 patents granted to Schwerin, Ges. für Elektro-Osmose m.b.H., and Farbwerke vorm. Meister, Lucius & Bruning.

Plant for Sale.—Plymouth Corporation invites tenders for a 500-kw. 500/550-volt d.c. generator, direct-coupled to a triple-expansion engine. See our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Bacup.—Extensions.—The T.C. has approved a draft agreement for the supply of electricity to Messrs. Taylor and Hargreaves' Irwell Mill and associated firms.

Barrow.—Year's Working.—The revenue of the T.C. electricity department for the past year amounted to £58,000, compared with £62,000 in the preceding year. This is accounted for by the receipts from Messrs. Vickers, who are now largely supplying their own requirements, decreasing by over £8,000. The income from energy supplied for heating, cooking, &c., increased by nearly £5,000. The net profit was £4,800; but as certain charges were met out of revenue, the actual figure is about £1,850. The output last year was 10¼ million units. The department has arranged for a considerable supply to the wire works, and expects new business at the graving docks, oil tanks, and ferro-concrete shipbuilding works.

Basingstoke.—Oil Fuel.—The T.C. has adopted a scheme drawn up by the electrical engineer, Mr. G. Broadhurst, providing for the fitting of Smitar's pulverisers to the Diesel engines, by which a considerable economy in crude oil is expected. Instead of each engine consuming a minimum of 12 lb. of crude oil per hour, they will be started on crude oil, and, after running five minutes, changed over to tar oil. In addition to an annual saving of at least £250, it will be possible to keep the engines running for longer periods; the present ring-type pulverisers have to be cleaned out three times per week, whereas with the new pulverisers this will only be necessary after the engines have run 800 hours, a net saving of 21 hours per week.

Belfast.—Price Increase.—The Corporation has increased the price of electricity by ·375d. per unit for lighting and by ·75d. for power, the advance to take effect from the end of the present quarter.

Birmingham.—Nechells Station.—The City Council, on August 6th, resolved to proceed with the amended scheme for the permanent generating station at Nechells, for the mains and sub-station equipment, and for the provision of a linking-up main between the Nechells station and the Smethwick boundary, at an estimated cost of £1,626,140.

Bolton.—Linking-up.—In order to secure a stand-by supply, the E.L. Committee has authorised the linking-up of its system with that of the Lancashire E.P. Co.

Brighton.—Year's Working.—The annual accounts of the electricity undertaking for the year ending March 31st last show that the total capital outlay to date was £845,957, an increase of only £1,467 on the previous year. The debit charges amounted to £37,937, being £16,904 interest and £21,033 sinking fund, and the amount provided for extinction of debt now stands at £466,735. The revenue from all sources was £119,003, again the highest on record. The working expenses were £76,026, or 64 per cent., and, after providing for capital and other charges, the net surplus for the year amounts to £2,887. During the year 10,242,007 units were sold as follows:—Private lighting, 3,098,313; public lighting, 32,086; power, 3,003,034; tramways, 1,907,537; bulk supply, 101,907; and special contracts, 2,099,130. The load factor was 25·3 per cent. and number of consumers 7,031.

Canterbury.—Price Increase.—The T.C. has advanced the price of electricity, from September 30th next, as follows:—Lighting, flat rate, to 6d. per unit; maximum demand rate, to 7d. and 3d.; outside arc lamps, to 6d.; motor-generators, to 3d.; gas compressors for lighting, to 6d.; power and heating, to 3d. Power consumers are to have a rebate of ¼d. per unit if over 500 units are consumed per quarter, and 1d. if over 5,000.

Chesterfield.—Bulk Supply.—With the object of saving fuel, the T.C. has decided to take a weekly supply of electricity in bulk from the Staveley Coal and Iron Co., and to stop production at the electricity works during the time the bulk supply is available.

China.—Hydro-electric Scheme for Kobe.—The municipal authorities of Kobé, says the *London and China Telegraph*, contemplate undertaking a hydro-electric enterprise, and it is now reported that they have found a suitable source of power on a section of the Chigari, on the upper reaches of the Muko River, about 20 miles from Kobé. Mr. Kobori, director of the Electric Bureau in the Kobé City Office, says the site selected is a very suitable one, and application for permission to use the river will be shortly made to the proper authorities. It is proposed to obtain about 5,000 kw. on an average, with a maximum capacity of 10,000 kw., and it is estimated that the undertaking will cost about 3,500,000 yen. When the proposed enterprise has materialised, it will be possible to supply Kobé with about one-third of its present supply of electricity.

Clayton (Yorks.).—Prov. Order.—The U.D.C. has decided that an old resolution, deciding to apply for a prov. order to supply electricity within its area for lighting, be rescinded, and that it should now apply for a prov. order to supply electricity for all purposes. This, it was stated, would complete the satisfactory agreement which had been reached with the Bradford Corporation.

Continental.—Spain.—At the annual meeting of the Sociedad Minera y Metallurgica, held in Paris, it was announced that a hydro-electric plant of 10,000 kw. capacity was being established to utilise certain waterfalls in the Veste d'Aure valley, and that contracts had been entered into with the French Government for the supply of the power required by a number of works in the district.

An application has been made for the use of 630,000,000 cb. metres of water yearly from the river Albercke (a tributary of the Tagus). A simple system of dams and canals will render available 40,000 h.p. It will be necessary to construct five power houses, all of which will be within 50 miles of Madrid.

Don José Barro Polo, of Vivero, has been granted the use of 1,000 litres of water per second in the dry season and 4,000 litres per second in winter, on the river Landro. This concession is in addition to those already exploited by Senor Barro on the same river, and will supply approximately 3,000 h.p.

Don José Galan has been authorised to make use of 12,000 litres of water per second from the river Genil, near Seville, for the generation of electrical energy.

The firm of Piccard Pictet & Co., Geneva, Switzerland, has under construction two water-wheels for La Catalona de Gas y Electricidad, S.A., of Barcelona. One, of 4,250 h.p., is for a fall of 45 metres; the other, of 2,800 h.p., is for a fall of 20 metres.

Sweden.—A small company has been formed at Gavle, with the title Hemlingby-Jarvat Kraftoch Belysnings Aktiebolag, to supply the towns of Hemlingby and Jarvat with electricity.

Hungary.—The Government has appointed a Committee of experts to draw up regulations restricting the consumption of electricity for lighting and power purposes, with the object of economising in fuel consumption.

Dartford.—Price Increase.—The U.D.C. has advanced the price of electricity for lighting by 20 per cent., making 60 per cent. on pre-war rates, and for power by 20 cent., a total increase of 65 per cent., from October 1st next.

The West Kent. E.P. Co. has notified the Council of its intention to lay cables in the Council's area.

Derby.—Price Increase.—The T.C. has raised the increase on electricity charges from 20 per cent. to 40 per cent. from August 1st last.

Dublin.—Proposed Restrictions.—The Corporation Electricity Committee has received deputations from the Building Trades Employers' Association and the employés of the D.S.E. Railway protesting against the proposed restrictions in the supply of electricity to manufacturers. The chairman of the Committee states that the electricity undertaking requires 38,000 tons of coal per annum to furnish a normal supply, but has been notified by the Controller that it can only have 18,000 or 19,000 tons for the current year. If every domestic and office user were disconnected the saving would not be sufficient to meet the proposed reduction in the amount of coal available.

Supply to Dockyards.—The E.S. Committee has placed an order with the Workshops Committee for the erection of a sub-station at North Wall Docks, and has guaranteed that a supply of electricity will be available for the two Dockyards within a month of the receipt of the material for the building of the sub-station.

Eccles.—Price Increase.—The T.C. has decided to advance the price of electricity, from the end of the September quarter, by 16⅔ per cent., making 50 per cent. above pre-war rates.

Elland.—Loan.—The U.D.C. has approved of a loan of £2,000 for electricity extensions.

Ellesmere Port.—E.L. Order.—The U.D.C. has decided to apply to the B. of T. for a further extension of time for carrying out the compulsory works included in the Schedule of its Lighting Order.

Finchley.—Year's Working.—There was a net deficit of £2,887 on the past year's working of the T.C. electricity department. The gross profit was £8,210, of which interest absorbed £3,596, and sinking fund charges £7,130. Units sold increased by 551,000 over the previous year. The cost of fuel had increased by £7,800.

Glasgow.—Price Increase.—The charges for electricity have been increased by the Corporation, and are now as follows:—Lighting, maximum demand, 5½d. and 1½d. per unit; churches, schools, &c., 4½d.; power, maximum demand, 2½d. and 1½d.

Grantham.—Price Increase.—The Urban Electric Supply Co. has intimated that, from July 1st last, the charge for electricity for power and heating will be increased by a further 10 per cent., making 40 per cent. in all.

Guildford.—Electric Light Failure.—On Wednesday night, last week, the electric light failed for some hours owing to the illness of the only stoker at the local electricity works.

At Aldershot also the electric light failed on the same evening.

Hereford.—Price Increase.—The T.C. has increased the price of electricity by 5 per cent. as from September 29th next.

Heywood.—Price Increase.—The Electricity and Tramways Committee has decided that the charges for electricity for all purposes be increased by 10 per cent. from October 1st next, and that motor hire charges be increased by 50 per cent. from the same date.

Hornsey.—Fire.—A serious fire occurred at the electricity works on Saturday last, involving the loss of several hundred tons of coal. Spontaneous combustion in the coal bunkers is supposed to have been the cause of the outbreak.

Kirkburton.—Prov. Order.—The seal of the U.D.C. has been given to the application of Huddersfield Corporation to the B. of T. for a prov. order to supply electricity within the district for all purposes.

London.—St. Pancras.—The B.C. has decided to offer to the War Office, for £1,600, one of the Browett-Lindley sets now used as a stand-by.

Luddenden Foot (Yorks.).—Prov. Order.—The Electrical Distribution of Yorkshire, Ltd., has informed the U.D.C. of its intention to apply for a prov. order, before December 21st, to supply electricity within the Council's area. The Halifax Corporation has notified the U.D.C. of its intention to renew its application for a similar Order next session.

Maidstone.—Price Increase.—The T.C. has again increased the price of electricity, as from July 1st last, by 10 per cent., a total increase of 15 per cent., and by 2½ per cent. to contract consumers.

Proposed Loan.—A loan of £22,007 has been applied for.

Middleton.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £7,500 in respect of capital expenditure on new cable, plant, and alterations at the electricity works in connection with the conversion of the works into a transforming and distributing station to deal with a bulk supply from Manchester.

Mytholmroyd.—Proposed E.L.—The Halifax Corporation has informed the Mytholmroyd U.D.C. of its intention to renew its application to the B. of T. next session for a prov. order to supply electricity within the Council's area.

Newcastle-under-Lyme.—Year's Working.—The revenue of the Corporation electricity department for the year ended March 31st last amounted to £3,784, an increase of £369 compared with the previous year, whilst the expenditure increased from £1,972 to £2,414. After meeting capital charges the net loss was £293, against £253.

Price Increase.—The charges for electricity have been increased as follows:—Lighting, 6d. per unit, plus 40 per cent., less 5 per cent. for cash within one month; power 2d., plus 50 per cent. less 5 per cent.; heating 3d., less 25 per cent.; for kinemas, lighting 5d., plus 40 per cent., less 2½ per cent., for cash within 14 days; power 2d., plus 40 per cent. less 2½ per cent.

Newport (Mon.).—Price Increase.—The E.L. Committee recommends an increase of 5 per cent. in the price of electricity to all consumers, making 50 per cent. over pre-war rates, and of 10 per cent. to consumers in bulk.

Radcliffe.—Price Increase.—The T.C. has decided, from the end of the present quarter, to increase the charges for electricity as follows:—Private and public lighting, 10 per cent., making a total increase of 40 per cent.; small power users, 10 per cent., making 50 per cent., except consumers subject to a coal clause; power users on sliding scale and on maximum demand rates, the existing charges, plus operation of coal clause.

Rathmines (Dublin).—Strike.—The strike of the employés at the U.D.C. electricity works has ended on the Council agreeing to refer to arbitration the question of an increase of £1 per week on pre-war wages.

Salford.—Price Increase.—The Electricity Committee recommends the Council to increase, as from September 1st, the advances over pre-war rates for the supply of electricity as follows:—Lighting, from 20 per cent. to 30 per cent.; power and heating, including bulk supplies, 30 per cent. to 50 per cent.; traction, 15 per cent. to 35 per cent.

Salisbury.—Proposed Purchase.—With reference to the purchase of the E.L. and Supply Co.'s undertaking, the T.C. has ascertained that it has no option of purchase until within six months of the expiration of 42 years from 1895.

Sheffield.—Proposed Loan.—The Treasury has intimated that it has no objection to the proposed borrowing by the Council of £1,203,950, in connection with the power house and equipment for the main scheme at Blackburn Meadows.

Stalybridge.—Year's Working.—The Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board reports that in the electricity department for the year ending March 31st last, the gross profit amounted to £36,220, of which interest and special payments absorbed £10,138; the amount transferred to sinking fund was £14,311, leaving a surplus of £11,771.

Stockport.—Year's Working.—The annual report for the year ending March 31st last, shows that the output of the electricity undertaking has risen to 24,500,598 units, with an average selling price of 0·78d. per unit, on which the undertaking is yielding a gross profit of 14·1 per cent. on a total capital expenditure of £218,730 and a gross profit of 26·4 per cent. on the outstanding capital of £117,701. Of this total capital expenditure £16,361 was contributed from revenue account, and £87,057 has been expended during the last five years. From the profits a sum of £4,750 was set aside for relief of rates, and sums amounting to

£7,114 have been set aside for depreciation of tramway plant. The balance of the electricity reserve fund was £2,884, and the total sinking-fund charges were £10,616. Total income for the year was £81,861 and the working expenses were £50,791; the gross profit being £31,070. Total works cost was 5d. per unit; maximum load on station was 8,400 KW.; and the number of consumers was 1,607. The units sold were:—Public lighting, 200,000; private lighting, 699,076; power, 20,934,871; and traction, 2,666,651; being a total of 200 units per head of population.

Swansea.—Supply to Docks.—Arrangements have been made for the supply of electricity by the Corporation to the King's Dock power house of the Harbour Trust.

Torquay.—Price Increase.—The T.C. has increased the charges for electricity for lighting from 6d. to 7d. per unit, and for power from 1½d. to 2d., as from the Michaelmas reading of the meters, and the town clerk is communicating with the Tramway Co. with regard to an increase in the charges paid for energy.

Whitstable.—Overhead Wires.—The Blean R.D.C. has consented to the E.L. Co. erecting poles for overhead wires for conveying energy to Whitstable-cum-Seasalter.

Wolverhampton.—Price Increase.—The T.C. has decided to increase the price of electricity, from June last, by 15 per cent. to ordinary consumers, and to further advance the charges by 10 per cent. for every increase of 2s. 6d. per ton in the price of coal.

TRAMWAY AND RAILWAY NOTES.

Australia.—Standard Tramway Rail.—A Conference of Electric Tramway Engineers was held (May, 1918), in Sydney, N.S.W., to consider the adoption of a standard grooved girder tramway rail for use by electric tramway undertakings in the Commonwealth. Owing to the difficulty—due to the war—of importing rails from overseas, the manufacture of rails in Australia becomes necessary.

The Broken Hill Proprietary Co., Ltd., which has steel works and rolling mills at Newcastle, N.S.W., has stated that it will consider the installation of a plant to roll grooved girder rails if a standard rail is adopted.

The Conference passed the following resolutions:—

1. That a standard girder rail be adopted for the tramways of the various States of the Commonwealth.
2. The weight of the girder rail for tangent track shall not be less than 90 lb. per lineal yard; the exact weight being subordinated to the design.
3. That the height of the girder rail be not less than 6 in.
4. That the width of the flange shall not exceed the height of the rail by more than ¼ in.
5. That the Conference is agreed that the form of groove and guard of the rail should take the form of the present standard of the American Electric Railway Association.
6. That the tread of the proposed section of rail shall approximately conform to that shown in blue print No. 3,365 of the Adelaide Municipal Tramways Trust.
7. That Mr. Cowdery, engineer for permanent way, N.S.W. Government tramways, be asked to get from the manufacturers the chemical and physical tests of steel that they can guarantee for tramway purposes, and that it be left to him to design a rail in conformity with the resolutions of the Conference.

The tread referred to in resolution (6) is struck to a radius of 12 in., with a $\frac{1}{16}$ in. radius on the running edge, which the Conference believed would tend to give a longer life both to wheels and rails.

Blackburn.—Service Restrictions.—The Tramway Committee has decided that the tramway service shall cease at 10 p.m. daily, and not start until 2 p.m. on Sundays.

Bolton.—Increased Fares.—The Tramway Committee has abolished workmen's fares on certain stages, and has increased other workmen's fares by 50 per cent. The service has also been reduced.

Continental.—Austria.—The conditions prevailing in Vienna are illustrated by the report submitted to the City Council on the electric tramway system, according to which tramways are practically the only means of transport in the city, and they have to convey soldiers and to transport coals, potatoes, and vegetables. In the past four months 1,900 dead bodies have been conveyed by the tramways to the suburban cemeteries. The number of cars running is reduced to 780, 20 of which have to be withdrawn each week for repairs, and there is no means of getting them repaired. There is no material with which to make the repairs, and the men in the workshops are so underfed that they have not the strength to do the work. More than half the employés are women, and those in the workshops are of very little use. The only material available for insulation in the motors is silk, such as was formerly used in making dresses, and this is extravagantly expensive. The company maintains that, in order to ensure a fairly normal service in winter, it is necessary at once to stop the running of cars at 9 p.m.—*Morning Post.*

Darwen.—Service Restrictions.—The T.C. has decided that the tramway service shall not commence until 2 p.m. on Sundays, and shall cease at 10 p.m. every day.

Dewsbury.—Fare Increase.—In order to discourage short-distance travelling, the Tramway Committee has decided to increase the fare for the first mile to 1½d.

Halifax.—Proposed Linking-up.—The Tramway Committee has decided not to entertain the proposal to connect the mains of the Yorkshire E.P. Co. with the Corporation mains, in order to secure a stand-by supply. The estimated cost of the scheme was £3,000.

Wages.—The Corporation has increased the wages of male tramway workers to 25s. per week over pre-war rates.

Price Increase.—The Electricity Committee has recommended that the charge for energy used in connection with the tramways be increased from 1½d. to 1½d. per unit.

Leicester.—Wages.—The Tramway Committee has increased its employés' wages by 5s. per week, making 25s. over pre-war rates.

Liverpool.—Fare Revision.—The Corporation has increased the 1d. tramway fares to 1½d., and has instituted shorter 1d. stages.

London.—L.C.C.—Only half a million copies, half the usual number, of the tramway map and guide are to be issued in 1918-19.

A tramcar burst into flames while proceeding along the Peckham Road on Saturday night. No one was injured, and the still burning car was pushed by another car to the depôt at Camberwell Green.

On Monday two tramcars became interlocked at the junction where Clerkenwell Road joins Rosebery Avenue, and traffic on the lines was stopped for some time. Meanwhile, both east and westbound cars had to be diverted over other routes.

L.U.T.—A loose trolley head tore down the overhead wires on both roads of the system at Brentford, and disorganised the service during the week-end.

Monte Video.—Strike.—Collisions between the police and the tramway strikers have taken place, and there have been several casualties. The Trade Unions have declared a general strike.—*Financier.*

Newcastle.—Fire.—Damage estimated at £150,000 was done by a fire which occurred on Sunday last in the electric train sheds covering five acres on the North-Eastern Railway. There were 97 self-propelled electric coaches under cover at the time, and the woodwork of many of them, also that of the platforms, was quickly involved. In all 38 of the coaches were burnt, together with a quantity of tools and almost the whole of the sheds. Steam trains were used to deal with traffic to the coast.

Nottingham.—Service Reduction.—In order to economise energy, the T.C. has entirely discontinued the Sunday tramcar service.

Preston.—Year's Working.—The receipts of the Corporation tramway department last year amounted to £63,097, an increase of £5,413 over the previous year, and expenditure increased by £7,463. The net profit was £4,158, against £7,581. After contributing £5,500 to the relief of rates, and paying £2,381 out of revenue to the new car-shed and offices, the credit balance of the revenue account stood at £1,738. The reserve fund was increased to £52,231, of which £43,375 has been invested in war securities and £7,734 used for capital purposes.

Radcliffe.—Price Increase.—The T.C. has applied to the Bury Tramway Committee for increased payment for energy supplied to the Radcliffe tramways.

Southport.—Increased Fares.—The Tramway Committee has recommended an increase of ½d. on all Army fares.

Stalybridge.—Year's Working.—During the past year the income of the tramway department of the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board was £55,903 and the expenditure £40,186. Interest and special payments accounted for £11,804, and £8,862 was transferred to the sinking fund, leaving a deficit on the year's working of £4,949.

Wolverhampton.—Year's Working.—The accounts for the year ended March 31st last of the Corporation tramway undertaking show that the gross profit for the year was £29,850, to which must be added £2,189 on motor char-à-bancs account, representing a total of £32,039, which was disposed of as follows:—Interest on capital, £5,616; income-tax on profits, £308; repayments of loans, £6,219; improvements, £198; reserve and renewals fund, £4,351; maintenance and repairs suspense account, £8,767; rate relief, £6,580. The expenditure was:—Operating costs, £28,946, an increase of £4,845; general charges, £5,635, an increase of £121; maintenance and repairs, £8,047, an increase of £912. The income was 16·67d. per mile run, or £76,193, an increase of £10,347. The car-miles run were 1,096,868, and passengers carried numbered 17,126,210; total working expenses per car-mile, 13·7d.; number of passengers per car-mile, 15·6.

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—September 4th. Victorian Railway Commissioners. 800 lighting transformers for signal system. A copy of the specification may be seen at the Inquiry Office of the Department of Overseas Trade (Development and Intelligence) in London.

Spain.—Tenders are invited for the supply, either new or second-hand, of one three-phase transformer, 9,600/220 volts, 140 KW., 50 cycles; one three-phase motor, 220 volts, 150 H.P., 1,000 R.P.M.; one D.C. generator, compound-wound, 100 KW., 500 volts, 1,000 R.P.M. Tenders to be sent, in duplicate, to the offices of La Sociedad Tranvia de Mondariz a Vigo, Calle Génova 16, Madrid.

August 23rd. The municipal authorities of Don Benito are inviting tenders for the concession for the electric lighting of the town; no specific period is mentioned.

Wigan. — Corporation. August 19th. Extension to engine room and switch room. Borough Engineer.

CLOSED.

Bridlington.—T.C. Coal for the Electricity Works. Bullcroft Main washed smalls. Mr. W. B. Wilson, York. £1 6s. 4d. per ton.

Carnarvon.—Electricity Committee. Conversion of the Diesel engine to run on tar oil, £107. Electric Construction Co., Ltd.

Sheffield.—City Council.

Steel chimney at Neepsend power house.—Mr. G. Cooper.

Salford.—Town Council.

William Muir & Co., Ltd.—8-in. stroke tramway slotting machine and accessories, £190.
Stewarts & Lloyds, Ltd.—16 steel elbow pipes, £195.

Swansea.—Harbour Trust.

Half a mile 7/12 aerial cable, £54; one mile 7/14 ditto, £65; one mile 7/18 ditto, £28.—W. Richard, Ltd.
Two miles No. 8 galvanised steel wire, 46s. cwt.—Richard Johnson, Clapham, and Morris.

NOTES.

National Electricity Supply.—A conference of representatives of publicly-owned electricity undertakings on the North-East Coast was held at Newcastle on August 4th, the Lord Mayor (Sir George Lunn) presiding, to consider the report of the Board of Trade Committee on Electricity Supply. The feeling of the meeting was not against the scheme, but was strongly opposed to bulk supply stations being in private hands, and a memorandum was considered with a view to representations being made to the Government in favour of such plants being controlled by a public Electricity Board. The proceedings were adjourned for a fortnight, without a decision being come to, in order that a pending report on the same subject from the Law Committee of the Municipal Corporations Association might be considered.

Volunteer Notes.—London Army Troops Companies, Volunteer Engineers.—Headquarters: Balderton Street, Grosvenor Square, W. 1.

Corps Orders No. 34, by Lieut.-Colonel C. B. Clay, V.D., Commanding:—
Captain of the Week.—Capt. E. G. Fleming.
Next for Duty.—Capt. W. Hynam.
Monday, August 19th.—Demolition Lectures, 5.30 and 7.30. Signallers, 6.30.
Tuesday, August 20th.—No. 3 Company, Entrenchments, 5.30. Lecture: "March Discipline"—Officers and N.C.O.'s, at 6.30. Recruits' Drill, 6.30.
Wednesday, August 21st.—No. 1 Company, Entrenchments, 6.30. Recruits' Drill, 6.30.
Thursday, August 22nd.—No. 2 Company, Entrenchments, 6.0. Recruits' Drill, 6.30. Signallers, 6.30. Ambulance Section, 6.30. Band Practice, 7.
Friday, August 23rd.—Range, 5.30—6.30 and 7.30—8.30. Lecture: "Railway Transport"—Officers and N.C.O.'s, 6.30.

C. Higgins, *Capt.* R.E., *Adjutant.*

Guide to Wandering Airmen.—According to the *Times*, a Swiss Federal Cross, lighted with electricity and over 50 yards in dimensions, has been installed on a plateau near the Franco-Swiss-German borders for the guidance of belligerent aeroplanes.

Fatalities.—On the 7th inst., an inquest was held at Stourport, touching the death of Arthur Wilson (16), of Till Street, who was killed at the Portwood Spinning Co.'s works, where he was employed as a mechanic's apprentice. Evidence was given that on Tuesday, last week, the deceased and the electrician, Edgar Oldham, went to the top of the hoist to repair an installation. The current had been switched off. Whilst deceased was in contact with a terminal, he suddenly called out: "Oh! it's alive," and fell across the beam. Oldham prevented him from falling down the hoist well, and lifted him out on the roof. Artificial respiration was tried, without success. Oldham said that when on the roof, directly afterwards, the hoist man (William John Barrett) said: "I must have touched the switch with my shoulder." He had no recollection of touching it with sufficient force to put the current on. A verdict of "Accidental death" was returned, no one being to blame.

An inquiry was held at Newcastle-upon-Tyne, on the 7th inst., into the circumstances of the death of Stanley Dunn Bavin (17), an apprentice plater, of Wallsend-on-Tyne, who was killed at the Neptune Works of Messrs. Swan, Hunter & Wigham Richardson, Ltd., Walker, on Friday, 2nd inst. John Stanley College, an apprentice plater, stated that he and Bavin, with others, were engaged in punching a shell bar at an electrically-driven machine. The bar was held by an overhead crane, and Bavin was steadying the bar with a "dog" bar. Witness had hold of one of the chains by which the bar was slung, when he received an electric shock. Looking round, he saw Bavin on the ground. Anthony Vashkevich, foreman electrician, said he examined the machine after the accident, and found that the terminal wires, as a result of the vibration of the machine, had become bare and dropped on to the compensator-box, on which there were signs of burning. The only explanation he could give of the accident was that the earthing wire from the compensator-box to a water pipe had become defective; it was practically burned through, and came off in his hands when he touched it. The machine where the accident occurred had been working night and day for three months. It was overhauled in June. Witness, in answer to Mr. W. B. Lauder, factory inspector, said that if the machine had been properly earthed it would not have become charged in such a way as to give a shock to the man working it. He agreed that copper wire twisted round the tubes carrying the cable and twisted round the water pipe was not a proper way to earth a machine. A verdict of "Accidental death" was returned, and the jury expressed the opinion that the means used to earth the machine were defective.

In order that expert opinion might be obtained, the Dublin City Coroner (Dr. L. Byrne) adjourned an inquest respecting the death of Dennis White, electrician, which occurred at a munition factory where he was employed on rewiring work at a hooter. The evidence showed that deceased was seated on an iron girder, with his hands on an overhead electric wire, which happened to be alive, and he received a shock at 200 volts. When the current was switched off he fell 15 ft. on to the cement floor, his head striking a machine in the fall.

The works superintendent said the wire was dead on the morning of the occurrence, as the current had been switched off the night before. Witness, after the accident, found one of the wires partly cut, and the insulation was cut; the deceased was finding out whether the circuit was alive or not. It proved to be alive, and when he cut through it he received the shock. White's employer said the circuit did not comply with the Regulations of the Home Office or those of the Institution of Electrical Engineers or the Dublin Corporation; it should never have been connected in the way it was. The house surgeon at Stevens's Hospital, where White was taken, said that except for what had been stated he had no evidence that the man had received an electric shock. He had, however, sustained a depressed fracture of the skull.

Wood Pipe Line in New Zealand.—There has been completed at Oamara, New Zealand, a large wood pipe for the conveyance of water in connection with the borough electricity works. The pipe is 36 in. in diameter, and is continuous throughout its whole length of 1,635 ft. It has been laid in a trench. Its adoption was practically forced upon the Borough Council owing to the impossibility of procuring iron pipes of the dimensions required in connection with the hydro-electric undertaking. The pipe was made in Australia, and is intended to supply water to two Pelton wheels at a pressure of 105 lb. per sq. in., developing 650 H.P. continuously. It is a continuous stave wood pipe with steel clamping bands, and has a thickness of 1⅛ in.—*Board of Trade Journal.*

A 110,000-Volt Line to Berlin.—It is reported from Berlin that the supply of electrical energy from the great power station at Golpa-Zschornewitz to the German capital has recently commenced. The scheme has been carried out on behalf of the Raw Materials Department of the War Office, and in this way a proposal which occupied the attention of experts prior to the war has now been realised. The Raw Materials Department was induced to proceed with this undertaking owing to the necessity for ensuring a supply of energy particularly to works engaged on war contracts in Greater Berlin, and the electrical transmission of power is said to represent a saving of from 300 to 400 tons of coal per day in the supply of coal in Berlin. The length of the 110,000-volt overhead conductors is 81.84 miles; the three stranded cables are of aluminium, each of a cross section of 120 sq. mm. The conductors are arranged on Hewlett suspension and straining insulators attached to iron masts, and an iron earth cable of 50 square mm. is placed over the three conductors. The masts, which are erected at intervals of 250 metres, have been adapted for the accommodation of three further conductors. Wooden sleepers were selected as the foundation for the suspension masts and concrete for the stay and angle masts. The sub-soil, however, was in part so unsatisfactory that the use of iron concrete piles had to be resorted to for the foundation. It is possible to transmit 20,000 KW. over the line. The transformers at each end are of 16,000 KW., and have aluminium windings, and the distribution plant at Berlin is at 6,000 volts. The installation was begun in October, 1917, and most of the work had to be carried out during the winter.

Institution and Lecture Notes.—Institute of Metals.—The autumn meeting will be held in the rooms of the Chemical Society, Burlington House, Piccadilly, W. 1, at 7.45 p.m., on Tuesday, September 10th, and 4 p.m. on the following day, concluding the same evening. Amongst the papers to be read are the following:—"The Effect of Progressive Cold-work upon the Tensile Properties of Pure Copper," by W. E. Alkins; "Grain Growth in Metals," by Z. Jeffries, D.Sc.; "Annealing Cold-Rolled Aluminium Sheet by Abbreviated Exposures at Various Temperatures," by R. J. Anderson, B.Sc., Met.E.

Royal Society.—At a special general meeting called to consider the proposed expulsion of enemy members, it was decided that the delegates of the Society should raise the question at the forthcoming conference with the representatives of the Academies of Allied nations in October.

Diesel Engine Users' Association.—At the July meeting the usual annual donation to the benevolent fund of the I.E.E. was voted. Correspondence was reported with the Board of Trade in regard to exempting from the operation of the Lighting, Power, and Heating Order, so far as electricity supplies are concerned, consumers in areas in which electricity is generated by means of Diesel oil engines, on the ground that such electrical undertakings had already effected an important economy in the use of coal.

There was a short discussion on the subject of a recent alteration in the nature of certain lubricating oils used by members of the Association, and some criticism in connection with the supply to certain undertakings of a substitute oil in place of the lubricating oil formerly supplied. A discussion took place on the paper on "Atomisation and Turbulence," which had been presented at the previous meeting of the Association by Mr. P. H. Smith, who, in his reply, gave information concerning the advantages and disadvantages of the different systems of burning tar oil in varying conditions of loading and size of cylinders. Referring to questions that had been asked concerning mixtures of petroleum fuel oil and tar oil, Mr. Smith stated that he did not think mixed oils satisfactory, and that he would much prefer to run an engine on a straight oil.

Inland Water Transport.—Mr. Bonar Law has informed Mr. F. W. Fryer that his plan for the development of inland water transport by continuous cable haulage is to be considered by the Select Committee of the House of Commons on Canal Development.

Electric Annealing.—Electric annealing is being used at Brea, California, for restoring crystallised oil-well casing and rotary drill-pipes, particularly the latter. One joint is treated at a time. It takes about 15 minutes to heat a 6-in. pipe by electricity to the required temperature. A pressure of 600 lb. per sq. in. is applied to the ends of the pipe during this period.

Appointments Vacant.—Shift engineer, for the Borough of Rawtenstall Electricity Works; assistant charge engineer, 50s. + 20s. + 12½ per cent., for the West Ham Corporation Electricity Supply; junior mains assistant engineer, £170 p.a., for the Fife Electric Power Co.; shift engineer, 65s. + 12½ per cent., for the Leigh Corporation Electricity Works; charge engineer for the Bury St. Edmunds Corporation Electricity Works. See our advertisement pages to-day.

A Tribute to Central-Station Men:—

Some are doing their bit on shore,
And some on the mighty sea,
Some in khaki, some in blue,
But such as the likes of we
Are doing our bit from day to day,
But never a soul can see
That we are serving our home and King
With loyal fealty.

No stripes, no chevrons or ribbons gay
Adorn our arms or chest.
We might be slackers or shirkers, but
If it is put to the test,
You'll find that most of us wanted to join
The forces with the best
Red blood of Britain's manhood who
Have gone to their last long rest.

We couldn't. We're told that we must stop
At home and defeat the Hun,
By running the central stations from
The set to the set of sun,
So that the great munition works
Can turn out shells by ton.
But never a word of praise to say*
Our duty is well done.

We do not ask for a medal of bronze,
Or yet for an O.B.E.,
But in the wheel of munitions we
Are really the hub, you see;
So when you speak of aeroplanes, guns,
Just think of the likes of we,
Who toil and slave 'mid the turbines' war,
Is a central-station man's plea.

P. Gordon Hieatt, Derby.

* This must be poetic licence; the immense importance of electricity supply in the national service has been cordially recognised by Cabinet Ministers and other prominent men, and we have often drawn attention to the facts in our own columns.—Eds. Elec. Rev.

The Home Front.—Shorter working hours, without a wages reduction, are demanded by the engineering trades, and the Employers' Federation has been asked to arrange a conference to discuss the question.

The Plantation Rubber Industry.—In the *Times* Trade Supplement for August, Mr. J. S. M. Rennie gives interesting particulars of the plantation rubber industry. The following data are given in regard to the location and domicile of all the known rubber plantations:—Domiciled in the United Kingdom, 1,189,328 acres; in Straits Settlements, 98,095 acres; in Federated Malay States, 118,348 acres; in Ceylon, 57,000 acres; in Shanghai (British), 30,000 acres; in Holland and N.E.I., 260,000 acres; in France and Belgium, 100,000 acres; in U.S.A., 55,000 acres; and in Germany, 3,400 acres; or a total planted area of 1,911,171 acres. It will be seen that, based on domicile, the British Empire holds control of very nearly 80 per cent. of the whole planted area. If we rely on situ or place where planted, the control will be vested as follows:—

British.

F.M.S. and Johore	807,491 acres
S. Settlements	159,500 ,,
Ceylon	229,695 ,,
South India...	41,820 ,,
B. Borneo	29,880 ,,
B. Burmah	26,399 ,,
South Sea Islands	5,000 ,,

A total of 1,299,786 acres, or 67 per cent.

Dutch and Others.

Sumatra	352,455 acres
Java...	238,830 ,,
Dutch Borneo	10,100 ,,
Cochin-China	10,000 ,,

A total of 611,385 acres, or 33 per cent.

When in or about the year 1920 the above planted areas are wholly mature the resultant annual crop will be about 380,000 tons, and will be under control in the following manner:—British, 290,000 tons; Dutch and others, 90,000 tons.

Mr. Rennie estimates that in 1920, if Peace had come, unless some restriction on the supply of raw materials to our enemies were enforced, present enemy and neutral countries would consume 55,000 and the United Kingdom and Allies 325,000 tons. That is to say, they would obtain nearly 15 per cent. of the crop at the same price per lb. as those who have, by foresight and patience, brought the industry to its present position. The existing average market value of an acre of planted rubber is £135, and with a cost of production of, say, 1s. all in, a normal selling price of 2s. per lb., and an output per acre per annum of 375 lb., the resultant profit per capital unit of £135 is £18 15s., or, say, 14 per cent. on capital invested.

Using up Old Dry Cells.—In *Annales des Postes, Télégraphes, et Téléphones*, Messrs. Reynaud-Bonin and Houdas give particulars of investigations made by the French Telegraph and Telephone Department, with a view to utilising dry cells which have been exhausted. They find that, as a rule, only one-eighth of the manganese peroxide is decomposed; the old zinc is useless, the electrolytic paste is dried up, and crystals of ammoniacal zinc chloride pervade the paste, &c. By taking the cell apart, washing the bag which contains the positive electrode, cleaning off the crystalline incrustation, and putting the bag to work again with a new zinc and a new electrolytic paste, the cell thus rebuilt is capable of giving quite a considerable percentage of its original output. A further improvement can be made by pulverising the depolariser and immersing it in a 10 per cent. solution of hydrochloric acid for 24 hours, to remove the zinc, ammonia, reduced manganese oxide, &c., and using the purified peroxide in the construction of new cells.

Wireless Station.—The Telefunken Co., of Berlin, is to construct a wireless station near Kootwyk (Holland) to the order of the Dutch Minister of Waterways, for communication between Holland and its East Indian Colonies.

Educational.—University of London Engineering College.—Session 1918-19.—The next session commences September 30th. Particulars of the electrical engineering day and evening courses are given in our advertisement pages to-day.

Italian Combine in Electrical Industry.—H.M. Consul at Milan states that a limited liability company has been formed with a capital of 64 million lire (to be increased to 80 millions) to absorb Messrs. Franco Tosi, of Legnano, the Officine Insubri (ex Langen & Wolff), and the Soc. Elettrotecnica Galileo Ferraris (ex Thomson-Houston).

A Science Conference.—At the invitation of the Royal Society, a Conference of representatives of Allied nations will be held in London on October 9th to discuss the future conduct of scientific work hitherto carried out by international organisations. Amongst the subjects to be dealt with are standards of measurement, in which the foremost place is held by the metric system; the investigation of scientific problems in which co-ordination of observation is essential; the economical division of work; international scientific congresses; and the International Association of Academies, which aims at co-ordinating the activities of international undertakings.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Stafford T.C. has increased the salary of the electrical engineer from £337 10s. a year to £387 10s.

Nelson Town Council has increased the salary of Mr. NAYLOR, electrical engineer, by £25 per annum.

Southport Corporation Tramways Committee recommends that the salary of Mr. KENDREW, general manager, be increased from £300 to £400 per year.

The Peterborough T.C. has advanced the salary of Mr. T. ROWLAND, acting electrical engineer, from £278 to £330 a year.

The Maidenhead T.C. has increased the salary of the electrical engineer, Mr. MILTON, by 20 per cent.

Mr. WRAGG, A.M.I.E.E., the municipal electrical engineer, Paarl, Cape Province, has been appointed engineer to the Koffyfontein Mines, Ltd., Orange Free State.

Mr. H. H. LINCOLN, assistant engineer and draughtsman to the Sheffeld Tramways Department, has been granted three months' leave of absence for health reasons.

General.—Mr. H. G. WILLIAMS, M.Sc., who was formerly on the engineering staff at Messrs. Siemens Brothers Dynamo Works at Stafford, has been approved as Conservative and Unionist candidate for the Combined Universities Parliamentary Division. He was at one time President of the British University Students' Congress.

Mr. LYDALL, the well-known electrical engineer, who has been visiting South Africa to report on behalf of Messrs. Merz & Co. on the electrification of the S. African railways, has completed his investigation and is returning to England.

Mr. JOHN BRABY is leaving Wimbledon Corporation electricity works to take up the position of engineer-in-charge with the Woking Electric Supply Co., Ltd.

Roll of Honour.—Private H. T. DEVENISH, Cheshire Regiment, formerly in the general office of the India-Rubber Co., Silvertown, and Private E. SPOONER, Northants Regiment, who was in the instrument department of the same company, are prisoners of war in Germany. Corporal T. PURCHASE, R.F.A., who was in the cashier and buyer's office of this company, has been wounded in Italy.

Lieutenant (Acting-Captain and Adjutant) V. C. RUSSELL, Suffolk Regiment, younger son of Mr. Stuart A. Russell, works manager of the India-Rubber Co., has been awarded the D.S.O. for the following act of gallantry and devotion to duty in the field:—

"At a period when the situation was critical, the front having been forced in and the flank in the air, he took charge as the parties fell back and organised a fresh defence line, under heavy fire, which he held for several hours. Later, when forced again to withdraw, he was the last to leave, and then only when the enemy were within 40 yards."

Lieutenant Russell was awarded the Military Cross in November, 1917, and a bar in March, 1918. He has also been twice mentioned in dispatches, and twice wounded.

Corporal D. CLARK has received a commission, and is proceeding to Ripon for training. Previous to enlisting in the L.N.L. Regiment he was on the staff in the Darwen Tramway Manager's office.

Gunner W. R. PEERLISS, Anti-Aircraft Service, who has died of illness, was an electrician with Mr. Hunt, of S. Croydon.

Lieutenant (Acting Captain) R. B. WILMSHURST, Lincs. Regiment, who has gained the Military Cross for gallantry and devotion to duty by subduing a fire amongst ammunition, is the youngest son of Mr. T. B. Wilmshurst, electrical engineer for the borough of Derby. He has risen from the ranks.

Sapper R. T. JACKSON, who joined the Royal Engineers from the Rugby Works of the British Thomson-Houston Co., Ltd., has been drowned whilst on active service.

Private J. HOLT, died of wounds, was formerly employed by Messrs. Charles Macintosh & Co., Ltd., electric cable manufacturers, Hulme, Manchester.

Gunner P. HOUGHTON, R.F.A., wounded for the second time, and now in hospital at Gloucester, was an apprenticed electrician with Messrs. Heyes & Co., electrical engineers, of Wigan.

Acting Captain J. H. SEMPLE, Gordons, reported wounded, is a son of Mr. and Mrs. Robert Semple, Kirkburn, Tanzieknowe, Cambuslang. He joined the army on the outbreak of the war, and received his commission on the field at the battle of Loos, September, 1915. He has been Acting Captain since November. Prior to the war he was with Messrs. Mavor & Coulson, electrical engineers, Glasgow.

CHARLES SAUNDERS, A.B., Royal Navy, who was in the employment of the Central Electric Supply Co. at Grove Road generating station prior to enlistment in 1914, died of acute neuritis on July 26th, whilst on active service.

Second-Lieutenant R. A. JAMESON, Royal Scots, who was formerly on the staff of the telegraph department of the G.P.O. at Edinburgh, has been killed in action.

Captain J. B. JAMISON, Royal Irish Rifles, whose death in action has been confirmed, was employed in the Belfast Corporation's electricity department for some eighteen years.

Lieutenant J. GRAY, 2nd/4th Queen's Royal West Surrey Regiment (son of Mr. James Gray, managing director of the Electric Construction Co., Ltd.), has been awarded the Croix de Guerre (1st class) with palm leaves.

Obituary.—MR. FRANK GARRETT.—The death occurred on August 2nd of Mr. Frank Garrett, head of Messrs. Richard Garrett & Sons, the well-known agricultural engineers, and makers of the Garrett patent electric wagon, of Leiston Works, Leiston, Suffolk. He was 74 years of age.

O. HENRICI.—The death is announced of Prof. Olaus Henrici, LL.D., F.R.S., Emeritus Professor of the Central Technical College, aged 78. Prof. Henrici was justly loved and respected by the many students who attended his lectures, and by his former colleagues, and occupied a prominent position in British mathematical circles.

NEW COMPANIES REGISTERED.

Brown Bayley's Steel Works, Ltd. (151,000).—Registered August 1st. Capital, £800,000 in £5 shares (100,000 pref.). To take over the business of Brown Bayley's Steel Works, Ltd., registered in 1880, and to carry on the business of manufacturers of iron and steel, gas and coke, electric light and heat; chemical manufacturers, refiners, distillers, dye makers, shipbuilders, mechanical engineers, &c. The subscribers are:—E. Armitage, M.P., Farnley Hall, Leeds, ironmaster, 200 shares; W. Armitage, Dore Moor House, Sheffield, Major in H.M. Army, 200 shares; Lord E. Hamilton, Carlton Club, S.W., director, 200 shares; H. Brearley, Elmwood, Old Whittington, near Chesterfield, manager of steel works, 200 shares; M. R. Maniprice, Norwood, Dore, Sheffield, manager of steel works, 200 shares; T. Hagon, 33, Main Road, Handsworth, near Sheffield, secretary, 1 share; H. Ashford, 39, Waterloo Street, Birmingham, chartered accountant, 1 share. The first directors are: R. Armitage, M.P., W. Armitage, Lord E. Hamilton, H. Brearley, M. R. Maniprice (all British). Minimum cash subscription: Seven shares. Qualification, £1,000 shares or stock. Registered office: Attercliffe, Sheffield.

Fabric Rubber Co., Ltd. (151,073).—Private company. Registered July 30th. Capital, £25,000 in £1 shares. Manufacturers of india-rubber goods, waterproofs, airship proofing, leather goods, electric cables, and general contractors to Governments, States, railroad, shipping, and other companies, &c. The subscribers (each with 100 shares) are:—M. F. Frankenburg, 4, Park Lane, Higher Broughton, Manchester, rubber manufacturer; S. T. Rowe, Dunoon, Wilbraham Road, Chorlton-cum-Hardy, Manchester, buyer; H. Standring, Braeside, 221, Urmston Road, Stretford, incorporated accountant. The first directors are: M. F. Frankenburg, S. T. Rowe, and H. Standring.

East London Mica Co., Ltd. (151,149).—Private company. Registered August 8th. Capital, £1,000 in £1 shares. Manufacturers of and dealers in mica and talc, &c. The subscribers are: C. G. Grout, 7, Eastfield Road, Walthamstow, mica merchant, 400 shares; P. H. Butler, 10, Connaught Road, Chingford, mica merchant, 400 shares. Permanent directors: C. G. Grout and P. H. Butler. Registered office: 17a, Edinburgh Road, Walthamstow, E. 17.

Pneumatic and Electric Syndicate, Ltd. (151,145).—Private company. Registered August 8th. Capital, £50 in 2s. shares. To acquire the option to purchase patents for improvements in pneumatic and electrical appliances, &c. The subscribers are:—R. Warner, 10, Walbrook, E.C., accountant, 9 shares; Alethea Warner, same address, clerk, 1 share. Table "A" mainly applies. Solicitor: W. Sparks, 32, Walbrook, E.C.

A. M. T. Syndicate, Ltd. (151,149).—Private company. Registered August 9th. Capital, £5,000 in 4,500 10 per cent. pref. shares of £1 each and 10,000 def. shares of 1s. each. To acquire the patent rights in an instrument for automatically teaching the Morse Code, &c. The subscribers (each with one pref. share) are:—C. F. Gold, 465, London Road, Isleworth, land agent; H. Whitwell, 49, Fontayne Road, Stoke Newington, advertising agent. The directors are to be appointed by the subscribers.

Domestic Electric Co., Ltd. (151,091).—Private company. Registered August 1st. Capital, £100 in £1 shares. To sell, deal in, and manufacture combustion engines and other machinery, &c. The subscribers (each with one share) are:—H. A. Orme, Newbridge, Wolverhampton; C. Smith, 3, Salter's Hall Court, Cannon Street, E.C. 4, solicitor. The first directors are: W. Paul and H. Orme.

Howard Electrical Co., Ltd. (151,085).—Private company. Registered July 31st. Capital, £5,000 in £1 shares. Electrical engineers and contractors, carriers of passengers and goods, suppliers of electricity, &c. The subscribers (each with one ord. share) are:—M. Howard, 96, Loughborough Road, West Bridgford, Notts., electrical engineer; H. E. Crammond, 126, Radcliffe Road, West Bridgford, Notts., electrical engineer; J. T. Kemp, 19, Highfield Road, West Bridgford, Notts., electrical engineer; S. G. Leach, 26, Artillery Lane, E.C., electrical engineer. The first directors are not named.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

T. H. Brooker & Co., Ltd.—Memorandum of satisfaction in full on July 24th, 1918, of debentures dated March 22nd, 1911, and May 9th, 1917, securing £250 and £1,100 respectively.

Urban Electric Supply Co., Ltd.—Mortgage or charge dated July 4th, 1918, to secure advances not exceeding £75,000, charged on all the undertaking, property, and assets, present and future, including uncalled capital (floating charge), ranking immediately after the charges already created to secure the first mortgage debenture stock issued and to be issued. Holder: Minister of Munitions.

Laing, Wharton, Ltd.—Memorandum of satisfaction in full on July 16th, 1918, of mortgage debentures dated January 4th, 1918, securing £700, has been filed. Also registered: Mortgage debenture dated July 26th, 1918, securing £500, charged on all real and personal property, present and future, including uncalled capital. Holder: Minister of Munitions.

Maxim Lamp Works, Ltd.—Particulars of £4,000 debentures created April 8th, 1918, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £2,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Harry W. Cox & Co., Ltd.—Issues on September 1st, 1913, of debentures securing £100, part of a series. Satisfaction in full on June 20th, 1918, of debentures dated September 1st, 1913, securing £100, has also been filed.

CITY NOTES.

Westinghouse Electric and Manufacturing Co., U.S.A.

The report for the year ended March 31st last shows $15,405,681 surplus income after charges, including all taxes, a decrease of $2,674,208. This surplus was equal to $10.29 a share on $74,812,650 capital stock outstanding, against $15.10 earned the year before, when the capital stock outstanding was $59,855,500 up to February, 1917, at which time $15,000,000 new common stock was issued. Gross earnings, $96,735,407, against $89,225,442; sales cost, including taxes and adjustments, $80,225,937, against $72,077,752; manufacturing profit, $15,509,470, against $17,461,690; other income, $1,325,263, against $1,386,547; gross income, $16,834,733, against $18,848,237; interest, $1,429,052, against $768,348; surplus, $15,405,681, against $18,079,889; preferred dividends $229,902, against $279,909; common dividends, $5,310,946, against $3,750,000; balance, $9,794,833, against $14,049,980 Gross earnings (sales billed) include shipments since June 15th, 1917, from the machine works (formerly Westinghouse Machine Company); also $4,536,000 for munitions. The volume of sales billed for the regular products of the company was greatly in excess of any previous year. At April 1st the value of unfilled orders in hand was $147,857,580, of which $110,185,007 was for the company's regular products. No facilities heretofore employed on regular products are engaged on munition work. In addition to the regular quarterly dividends at the rate of 7 per cent. per annum on the preferred and common stock, a special "Red Cross" dividend was paid, making a total of $5,610,848 for all dividends during the year. Net surplus is $26,404,694, an increase of $8,299,396 over 1917. The chairman reports: In the latter part of 1916 a proposal was submitted to the directors for the purchase of a small portion of the holdings in the British Westinghouse Electric & Manufacturing Co., Ltd., in order that a controlling interest might be transferred from the United States to England. After careful consideration the directors concluded that the commercial position of the British Westinghouse Electric & Manufacturing Co., Ltd., would be improved if the control of that company were owned in England instead of the United States, but decided that the sale of the entire holdings was the only satisfactory solution of the situation. Accordingly negotiations were concluded under which the holdings of 4 per cent. debenture stock and preference and ordinary shares in the British company were sold to a syndicate formed in London (Electric Holdings, Ltd.) and payment therefor has been received in 5 per cent. prior lien debenture bonds maturing in 10 years. These bonds are secured by the pledge of all the said securities sold and certain other additional collateral. This change in the investments was made without change in book values, and has therefore not affected the balance-sheet.

Carbide Amalgamation.—The directors of the Alby United Carbide Factories propose to purchase the Nitrogen Products and Carbide Company. The latter owns the cyanamide works at Odda, Norway, to which the Alby Company supplies a large proportion of its output. It is proposed to capitalise and distribute a portion of the reserve by allotting one additional ordinary £1 share for every eight held. It is proposed to increase the capital of Alby United to £2,350,000 by the creation of 1,625,000 new ordinary shares of £1 each, ranking *pari passu* with the existing ordinary shares. Treasury sanction has been obtained to the issue of the necessary capital and its use for the purposes of this scheme. Nitrogen Products will go into liquidation and its assets and liabilities will be taken over by Alby United, which will give in exchange shares in its own capital. Alby United, as the holder of 500,035 shares of Nitrogen Products, is not to be entitled to claim any allotment of shares nor to be liable to pay any sums unpaid in respect of its holding in Nitrogen Products.

W. T. Henley's Telegraph Works Co.—Dividend on the preference shares at the rate of 4½ per cent. per annum, less income tax, for the half-year ending June 30th last, payable on the 31st inst. Also an interim dividend on the ordinary shares, to be paid on the 31st inst., of 2½ per cent., less income tax.

South Metropolitan Electric Light and Power Co., Ltd.—The transfer register and register of members will be closed from August 19th to 31st (both days inclusive), for the preparation of warrants for dividends payable the 31st inst. on the 7 per cent. cumulative first preference shares and 6 per cent. cumulative second preference shares for the half-year ended June 30th, 1918.

Electro-Bleach & By-Products, Ltd.—Interim dividend in respect of the current year of 3½ per cent., less income-tax at 5s. 6d. in the £, on the preference shares, such dividend being payable on September 1st next to the registered holders of the preference shares on August 9th.

Blackpool-Fleetwood Tramroad Co.—Interim dividend of 4s. per share, free of tax, the same as a year ago.

Lanarkshire Tramways.—7 per cent. per annum (7s. per share), less tax, for half-year (interim), payable 17th inst. Last year, 6½ per cent. per annum.

London & Suburban Traction.—It is not proposed to pay an interim dividend on preference shares on 15th inst. Last year, no interim dividend was paid.

Brompton & Kensington Electricity Supply.—7 per cent. per annum (3s. 6d. per share), less tax, on ordinary shares for half-year (interim). Last year, 8 per cent. per annum.

Leyland Motors (1914).—Interim dividend on ordinary shares, payable September 10th to holders registered 30th inst.

Hong-Kong Tramway.—7d. per share, less tax (interim), payable in Hong-Kong 21st inst. Last year 5 2-5d. per share.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to allow the following to be quoted in the Official List:—

Callender's Cable & Construction Co., Ltd.—40,000 additional ordinary shares of £5 each, fully paid.

Chili Telephone Co., Ltd.—Further issue of 22,000 shares of £5 each, fully paid (Nos. 66,001 to 88,000).

Lancashire Dynamo & Motor.—Final dividend of 6d. per share on the fully-paid £1 ordinary shares for 1917, and an interim dividend of 1s. per share for the year 1918 on the same class of shares, both free of income tax.

STOCKS AND SHARES.

Tuesday Evening.

At this holiday season of the year, it has been customary to "seize the opportunity" in this column of comparing the day's quotations with those that ruled at the beginning of the year. But with remembrance of the war's anniversary so shortly passed, it would appear more appropriate to match the current prices with those prevailing at the end of July, 1914, on the eve of the outbreak of war, and accordingly the tables which follow will point the differences that remain as a net result of the period.

Taking first the Ordinary shares of electricity supply companies, this is the comparison:—

Share.	July 27th, 1914.	August 7th, 1918.	Fall.
Brompton and Kensington ...	9⅛	6½	2⅝
Charing Cross	5½	3⅛	2⅜
Chelsea	4½	3⅛	1⅜
City of London	16	11⅜	4⅝
County of London	12	10½	1½
Kensington	7¼	5⅛	2⅛
London	1 1/16	1⅛	1/16
Metropolitan	3½	3⅛	⅜
St. James'	9⅝	6⅜	3¼
South London	3 1/16	3	1/16
Westminster	8⅝	6	2⅝

It is to be noted that whereas securities paying fixed-interest have fallen heavily during the period, shares of a speculative nature have in many cases improved. London Electricity Supply shares are mostly of a sound investment quality; and although dividends have fluctuated mildly during the period, the shares have little claim to be called speculative in any sense. Moreover, the industry has been hardly hit by such peculiar circumstances as, for instance, "Summer Time," and the falls in prices are not surprising, considering all things.

Electric Railway issues present the following changes:—

Stock.	July 27th, 1914.	August 7th, 1918.	Fall.
Central London	83	62½	20½
Metropolitan	37½	23¾	13¾
District	21¾	21¾	—
Underground Income ...	88	86	2
ditto "A" ...	7/6	6/6	1/-
ditto £10 paid ...	2½	2½	—

Heavy falls have occurred in some of the colonial and foreign stocks and shares, as, for instance:—

Stock.	July 27th, 1914.	August 7th, 1918.	Rise or fall.
British Columbia Def. ...	107	40½	— 66½
Brazil Traction	66	46½	— 19½
Canadian General	99½	111	+ 11½
Kaministiquia	126½	117½	— 9
Melbourne Electric	192	160	— 32
Mexican L. and P.	46½	21	— 25½
ditto First Bonds ...	81½	49	— 32½
Monterey Fives	50½	42	— 8½
River Plate Electric... ...	240	135	—105
Victoria Falls Pref.	13/9	23/9	+ 10/

Mexicans have suffered heavily because of the long-protracted chaos in the country. Canadian investments, after a bad time, began to improve as one and another of the industrial companies

started making munitions. A "good" group is that of the Telegraph and Telephone list, as these prices show :—

Stock.	July 27th, 1914.	August 7th, 1918.	Rise or fall.
Anglo-American Pref. ...	108½	96	— 12½
Direct U.S. Cable	5½	6½	+ 1
Eastern	130½	158½	+ 28
Eastern Extension	12½	15½	+ 2¾
Globe Telegraph	11½	14⅝	+ 3⅛
Great Northern	32½	37½	+ 5
Indo-European	59	58½	— ½
Marconi	1½⅜	4½	+ 2 7/16
West India and Panama ...	1½	1 7/16	+ 15/16
Western	13⅝	16	+ 2⅜

Manufacturing shares make the most interesting group, but comparisons are difficult, owing to the number of share bonuses and other gifts which the fortunate proprietors have received. We must make shift accordingly with a list that is obviously inadequate :—

Share.	July 27th, 1914.	August 7th, 1918.	Rise or fall.
Babcock & Wilcox ...	2¼	3⅞	+1⅝
British Aluminium ...	1	1⅞	+ ⅞
B. Westinghouse Pref. ...	1¾	2 13/16	+1 1/16
Callenders	11⅞	19½	+7⅝
Edison "A"	2/-	45/-	+43/-
India-Rubber	9	16½	+7½
Telegraph Con.	38½	44½	+6

This is a very brief summary of the movements of prices in shares connected with the electrical industry, but it helps to show clearly the trend of business over the last four years.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1916.	Dividend 1917.	Price Aug. 6. 1918.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	9	10	6½	—	£7 13 10
Charing Cross Ordinary	5	4	3⅜	— ⅛	6 8 0
do. do. do. 4½ Pref...	4½	4½	3½	—	6 18 6
Chelsea	3	5	3½	—	7 13 10
City of London	8	8	11½	+ ⅛	7 0 3
do. do. 6 per cent. Pref. ..	6	6	9⅝	—	6 0 4
County of London	7	7	10⅛	—	6 17 7
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	6	7	5½	—	6 13 4
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref...	4	5	3½	—	7 13 10
Metropolitan	3	4	3⅛	—	6 8 0
do. 4½ per cent. Pref. ..	4½	4½	3½	—	6 18 6
St. James' and Pall Mall	8	9	6¾ xd	—	7 1 2
South London	5	5	3	—	6 13 4
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	9	6	— ⅛	7 10 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	96	—	6 5 0
do. Def.	1½	1½	22½	+ ½	6 11 10
Chile Telephone	8	8	7½ xd	+ ¼	4 1 7
Cuba Sub. Ord.	7	7	10	—	*7 0 0
Eastern Extension	8	8	12⅝	—	*5 3 3
Eastern Tel. Ord.	8	8	158½	+ 1	*5 1 0
Globe Tel. and T. Ord.	7	7	14⅜	—	*4 17 5
do. do. Pref.	6	6	10	—	6 0 0
Great Northern Tel.	24	22	87½	—	5 17 4
Indo-European	13	—	58½	—	5 11 1
Marconi	15	20	4½	+ ⅛	4 17 1
Oriental Telephone Ord.	10	10	3 xd	—	3 6 8
United R. Plate Tel.	8	8	7½	—	*5 6 8
West India and Panama	6d.	9d.	1 7/16	—	*3 6 8
Western Telegraph	8	8	16	—	*5 0 0
Home Rails.					
Central London Ord. Assented ..	4	4	62½	—	6 8
Metropolitan	1	1	23½ xd	—	4 4
do. District	Nil	Nil	21	—	Nil
Underground Electric Ordinary..	Nil	Nil	2	+ ½	Nil
do. do. "A" ..	Nil	Nil	6/6	+ 9d.	Nil
do. do. Income ..	6	4	86	+ 1½	*4 13 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref. ..	6	6	4½	—	6 6
Anglo-Arg. Trams. First Pref. ..	5½	5½	3½	—	—
do. do. 2nd Pref. ..	5½	—	2½	—	—
do. do. 5 Deb... ..	5	5	65½	—	7 12 8
Brazil Tractions	—	—	46½	— ½	—
Bombay Electric Pref.	6	6	9½ xd	—	6 9 9
British Columbia Elec. Rly. Pfce.	5	5	61½	—	8 2 8
do. do. Preferred	Nil	Nil	45	—	Nil
do. do. Deferred	Nil	Nil	40½	—	Nil
do. do. Deb. ..	4½	4½	60½	—	7 0 6
Mexico Trams 5 per cent. Bonds..	Nil	Nil	44½	—	Nil
do. 6 per cent. Bonds..	Nil	Nil	30½	—	Nil
Mexican Light Common	Nil	Nil	21	—	Nil
do. Pref.	Nil	Nil	30	—	Nil
do. 1st Bonds.. ..	Nil	Nil	49	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3⅞	—	3 16 2
British Aluminium Ord.	10	10	1⅞	—	5 6 8
British Insulated Ord.	20	20	2	—	5 0 0
British Westinghouse Pref. ..	7½	7½	2½	+ 1/16	5 6 9
Callenders	20	25	19½	—	6 11 7
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	20	3 7/16	—	5 16 0
Edison-Swan, fully paid ..	—	—	2½	+ 1/16	Nil
do. do. 4 per cent. Deb. ..	4	4	75½	+1	5 6 0
Electric Construction.	7½	10	1 5/16	—	7 12 4
Gen. Elec. Pref.	6	6	10½	—	6 5 4
do. Ord.	10	10	18½ xd	—	*5 8 1
Henley	25	25	3½	—	5 17 8
do. 4½ Pref..	4½	4½	3½	—	5 12 2
India-Rubber	10	10	16½	—	*6 3 0
Telegraph Con.	20	20	44½	—	*5 7 8

*Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, August 14th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£80	..
a Ammonia, Muriate (large crystal)	,,	£75	..
a Bisulphide of Carbon	,,	..	..
a Borax	,,	£43	..
a Copper Sulphate	,,	£65	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	£17 5/-	..
a Sulphate of Magnesia	per ton	£15	..
a Sulphur, Sublimed Flowers ..	,,	£35	..
a ,, Lump	,,	£25	..
a Soda, Chlorate	per lb.	1/1	..
a ,, Crystals	per ton	170/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2' to 12' basis)	per lb.	..	..
c ,, Tubes (solid drawn) ..	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn) ..	,,	1/8½ to 1/9	
g ,, Bars (best selected) ..	per ton	£161	..
g ,, Sheet	,,	£161	..
g ,, Rod	,,	£161	..
d ,, (Electrolytic) Bars ..	,,	£137	..
d ,, ,, Sheets ..	,,	£153	..
d ,, ,, Wire Rods ..	,,	£145	..
d ,, ,, H.C. Wire	per lb.	1/5½	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/6	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/-	..
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£37	..
g Lead, English Pig	,,	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small ..	per lb.	6d. to 8/-	..
e ,, ,, ,, medium ..	,,	3/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	5/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

An Electrically-Operated Shipyard.—On July 25th the first keel-plate was laid by Sir Wm. Gray, at the new Egis Shipbuilding Yard and Works. The project was embarked upon to help in anticipating the steps required to maintain British shipping supremacy in commercial competition after the war. The chief promoters of the undertaking were Sir John Ellerman, Bart., and Sir Wm. C. Gray, Bart., and the management was entrusted to Messrs. W. Gray & Co., Ltd. A site was acquired on the banks of a river, which covers nearly 16 acres, and the sanction of the Admiralty to proceed with the lay-out of the yard and the erection and equipment of the shops was granted on August 29th last year. The shipyard is driven throughout by electricity—electric power and lighting are taken down between each berth—supplied on the three-phase system by the County of Durham Electrical Power Distribution Co., Ltd. The company has laid a special high-tension cable from its main cable system into the shipyard; this main terminates in a transformer sub-station situated in a central position in the shipyard, adjacent to both the compressor-house and the platers' shed, where the bulk of the electricity will be used.

Of the motors, which number about 80, more than half were supplied by the British Westinghouse Electric and Manufacturing Co., Ltd. The distributing boxes for the power system throughout the yard, as well as the main switchboard in the sub-station, which is of the ironclad type, were supplied by Messrs. A. Reyrolle & Co., Ltd. The transmission system between the sub-station and the various distributing centres in the yard consists of paper-insulated, three-core, wire-armoured cables, manufactured and laid by the British Insulated & Helsby Cables, Ltd. There are no overhead wires in the yard. The wiring between the distributing boxes and the individual motors and starters is of the open type, supported on insulators, protected in steel tubing where necessary, and has been carried out by Messrs. Falconer, Cross & Co.

With a view to securing continuity of operation and easy replacement in case of breakdown, everything has been standardised throughout as far as possible. Consequently, the number of different sizes of motors and other apparatus used in the yard is very small.

The system of lighting, both in the yard and the offices, is of the most modern type and exceedingly generous, since it is realised that good lighting brings ample return in good work.

THE POSITION OF THE ELECTRO-TECHNICAL INDUSTRY OF THE WORLD DURING THE WAR.

The course of the electrical industry of the world during the war is fully treated by M. Gurewitsch in the *Bulletin* of the Association of Swiss Electrical Engineers. Among the industries, he says, which have undergone great development, not only in belligerent but in neutral countries, the electrical industry takes an important place. From the outset of the war, the electrotechnical works in Germany, France, England, and the United States were able to adapt themselves quickly to the manufacture of munitions, and to realise large profits thereby. Let us take, for example, that establishment which is in the forefront of the German electrical industry, the Allgemeine Electricitäts Gesellschaft. According to the last annual report, electrical installations actually under construction had fallen in value from 48,000,000 to 46,600,000 marks. Notwithstanding this, the amount of business transacted was very considerable, which is explained by the extensive orders from the military authorities; the gross profit realised had allowed of the making of large extensions to the works. If a portion of these extensions was principally due to the needs connected with the manufacture of munitions, there remained no inconsiderable portion available for employment after the war, which would thus strengthen the financial position of the company. The net profits realised in 1916-17 were below those of 1912-13 by 2,470,000 marks (30,370,000 against 27,900,000 marks). Other electrical works in Germany, as well as in the other belligerent countries, achieved similar results. But the manufacture of electrical material generally had much increased, as the thousands of works supplying war requirements created an enormous demand for electrical machinery and plant. The rolling-mills in America during 1916 made calls for electric motors of a total power of over 200,000 H.P. (among which were units of 6,000 and 10,000 H.P.), while from 1905 to 1916 the yearly increase in the same industry was only between 40,000 and 60,000 H.P. The following table gives (in millions of dollars) an idea of the growth of electric production in the cases of three of the chief American companies:—

	1912.	1914.	1916.
General Electric Co. ...	90	90	120
Western Electric Co. ...	73	60	105
Westinghouse Co.	37	32	80

It may be remarked in passing that the first-named company increased its capital in 1917 by $20,000,000.

In the above figures war material is not included. Furthermore, only 7 per cent. of the output was destined for exportation; all the remainder was absorbed by the home market of the States. Nevertheless, as an outcome of the stoppage of German exports (which in 1913 totalled 467,500,000 fr., against 189,000,000 fr. for England and 146,000,000 fr. for the United States) the exports of the American electrical industry considerably increased. Hence the total exports of electrotechnical products rose from $28,200,000 in 1913, $19,960,000 in 1914, and $24,340,000 in 1915, to $40,240,000 in 1916. Thus the exports of 1916 exceeded to the extent of 43 per cent. the already fine figures of 1913.

Not only the American electrotechnical industry but that of Sweden likewise showed excellent results. That country was not only able to supply its own home markets, but also furnished large quantities of electrical products for exportation, especially to Russia. The largest Swedish electrical concern, the Allmänna Svenska Elektriska Aktiebolag at Västeras (A.S.E.A.) realised in 1916 a net profit of 12,400,000 kr., against 4,600,000 and 2,200,000 kr. in the two foregoing years. This company has increased in capital from 26,000,000 to 33,000,000 kr., and acquired a number of works—the Nya Förenade Elektriska A.B., the Svenska Turbin Fabriks A.B., the Liljeholmens Kabelfabrik, &c. Besides this, it has set up a foundry and a porcelain insulator works. The increase of the company's export business is shown in the following table (in millions of kroner):—

	1912.	1914.	1916.
Home market	13·9	20·6	39·4
Exports	3·8	6·2	10·9

Exports for 1916 were thus threefold those of 1912. The branch companies of the A.S.E.A. in Denmark, England, and Russia also did good business. During the war the company's position was so strengthened that it no longer had any fear of foreign competition in Sweden. For example, while imports of electrical machinery from Switzerland in 1913 were 316,000 fr., and in 1914 694,000 fr., the figures in 1915 and 1916 fell to 57,000 and 101,000 fr. respectively.

The English industry was too much occupied with war supplies to pay attention to the normal market. English exports consequently fell off, as the table below shows (in thousands of pounds sterling):—

	1913.	1915.	1916.
Exports of electrical machinery	2,275	1,391	1,552
Other electrical goods... ...	5,405	3,169	4,107
	7,680	4,560	5,659

In consequence of the enormous demands and the difficulties of manufacture, even for the home market, imports of electrotechnical products into England showed only a small reduction, namely:—

	1913.	1915.	1916.
Electrical machinery ...	1,345	1,522	1,088
Other electrical goods ...	1,587	1,096	1,653
	2,932	2,618	2,736

The most important supplier to England was the United States. Switzerland supplied machinery principally, exports rising from 1,234,000 fr. in 1913 to 2,014,000 and 1,798,000 fr. in the two following years. On the other hand, Swiss exports fell in 1916 to 642,000 fr., and in the first nine months of 1917 to 452,000 fr. It must be remarked that the manufacture of electrical machinery in England before the war was fairly well developed, machinery figuring as 30 per cent. of the total electrical exports. It must be believed, therefore, that after the war electrical construction works, enlarged and strengthened by supplying the military requirements, will be in a position to satisfy all the wants of the Empire. The manufacture of electrical machinery has, indeed, attained such a development in England that the Government, on November 16th, 1917, forbade imports as unnecessary. (Besides, Swiss industry, in the matter of machinery, can hardly struggle against that of England, as the former is 10 per cent. dearer.)

On the other hand, Swiss exports of measuring appliances to England greatly increased during the first three years of the war, as the figures below show (in thousands of francs):—

	1913.	1914.	1915.	1916.	Jan.—Sept. 1917.
Control and measuring appliances	181	332	387	402	89
Various...	118	307	473	297	176
	299	639	860	699	265

The prospects of the exportation of installation material into England should in general be favourable, for English manufacture of this material was very little developed before the war, insomuch that Germany exported to England in 1913 goods of this kind to the value of 9,752,000 marks. In reality, however, English works at the present moment are in a position to meet home wants, and to such a degree that the Government has, for example, forbidden the importation of meters.

France had greatly reduced its imports of electrotechnical products; these had fallen from 37,500,000 fr. in 1913 to 24,100,000 fr. in 1914, and to 24,400,000 fr. in 1915. But as since then the military calls for electrochemical and electrometallurgical products have enormously increased, a very intense constructive movement in the domain of hydraulics has begun. In consequence, French imports of electrical plant in 1916 rose to a value of 61,300,000 fr., subdivided as follows:—

	Fr.
Electrical machines	15,100,000
Apparatus and measuring instruments ...	15,400,000
Cable and leads	14,000,000
Armatures and machine parts	7,500,000
Various apparatus	9,300,000

French exports fell from 37,200,000 fr. in 1913 to 28,000,000 fr. and 26,300,000 fr. in the two following years: on the other hand, they rose in 1916 to 46,300,000 fr. This rise is chiefly explained by the large exports of electrodes, which varied as follows:—

	Fr.
1913	8,560,000
1914	6,320,000
1915	12,090,000
1916	25,760,000

From the point of view of quantity the export of electrodes in 1916 was only 10 per cent. more than in 1913, but the value was trebled. In the case of Switzerland, French exports of electrodes sank to a third in the same period: 765,000 fr. in 1913 and 244,000 fr. in 1916. We said previously that France imported electrical machines to the extent of 15,100,000 fr. A little less than half of these imports came from Switzerland, which exported machines to France in 1916 to the value of 6,900,000 fr. (30 per cent. of the total exports). In 1917 (January to September) exports to France reached the figure of 4,800,000 fr., whereas for the whole of 1913 the figures were only 4,170,000 fr. The considerable augmentation in the figures of Swiss exports of electrical machines to France is not explained merely by the increase in the price, but also by the larger quantity—namely, 16,432 machines in 1913, against 22,822 in 1916. In 1914 and 1915 exports fell to 3,000,000 and 3,500,000 fr. respectively. Swiss exports to France of "sundry apparatus" likewise increased after suffering a decline in 1914 and 1915. Thus the total rose from 1,461,000 fr. in 1913 to 1,975,000 fr. in 1916, and to 1,666,000 fr. in 1917 (January to September only). In the same period exports of Swiss glow lamps to France rose from 323,000 fr. to 1,269,000 fr., and in 1917 to 712,000 fr. for the first nine months only. Exports of batteries from Switzerland likewise advanced from 33,000 fr. in 1913 to 664,000 fr. in 1916; while, on the other hand, control apparatus and measuring instruments suffered a fall from 634,000 fr. to 348,000 fr. As a matter of fact, the manufacture of measuring apparatus is highly developed in France—to such a pitch that in 1913 that country was able to export these articles to the value of 14,600,000 fr. In 1914 and 1915 these exports fell to 9,100,000 fr. and 6,800,000 fr. respectively, rising, however, in 1916 to 12,100,000 fr.

The author believes that in the future France will be compelled to import electrotechnical goods, particularly when it is remembered that, according to American estimates, an expenditure

of 500,000,000 fr. on these articles will be needed in the work of reconstitution of the invaded provinces. According to the statistics of the president of the Syndicat des Industries Electriques, the yearly output in France of electrical goods before the war reached the total of 221,000,000 fr., which amount is subdivided as under:—

	Fr.
Dynamos, transformers, and electric cranes ...	66,000,000
Electric apparatus and lamps	67,000,000
Cables and leads	40,000,000
Telegraph and telephone apparatus	26,000,000
Sundry appliances	22,000,000

According to other estimates, the French output would be 300,000,000 fr. (against an output of 1,550,000,000 fr. in Germany in 1913, and 1,900,000 fr. in America in 1914), of which 100,000,000 fr. stand for electric machines and transformers, and 60,000,000 fr. for cables and leads. In any case, the French industry cannot suffice for itself. As regards Switzerland more particularly, the situation will be very favourable in view of the difficulty which Germany will meet with in the resumption of trade, her exports to France totalling, before the war, 18,000,000 fr. Switzerland will, however, have to reckon seriously with English and American competition.

Italy is unable, any more than France, to supply her growing requirements of electrotechnical products, and the more so, because her industry is less developed. Even in pre-war days she was obliged to have recourse to foreign industries (particularly those of Germany); in 1913, for example, Italy imported to the extent of 32,000,000 lire. Italian exports were unimportant, and only amounted to 10,300,000 lire. Three-fourths of the exports were made up of cables, shipped, for the most part, to South America. After the entry of Italy into the war, Switzerland occupied the position of Germany as the supplier of Italy. Swiss exports to Italy were as under (in thousands of francs):—

	1913.	1914.	1915.	1916.	(Jan.—Sept.) 1917.
Electrical machines ...	934	1,158	1,089	873	677
Control apparatus and measuring instruments	355	276	373	959	949
Telegraph and telephone apparatus	14	17	84	1,055	603
Glow lamps	276	252	1,420	2,589	3,113
Sundry appliances ...	489	507	245	579	395
	2,060	2,219	3,211	6,055	5,737

As in all the other belligerent countries, electrotechnical works in Russia have done good business, and dividends have been much greater than in peace times. Almost all the works have doubled their capital. The Russo-German A.E.G. Co., whose dividend for 1916 was 10 per cent., has been reconstituted, after its liquidation on July 1st, 1917, under the style of the General Electric Co. (A.E.K.), with a capital of 24 million roubles, one third of whose shares have been acquired by the Russian Government. According to the latest reports, this company (in which the American General Electric Co. has interest to the extent of 4,000,000 roubles) has raised its capital to 36,000,000 roubles. The Russian Siemens-Schuckert Works and the A.G. Siemens & Halske (whose dividends in 1916 were 7·5 and 12·5 per cent. respectively) have likewise been liquidated, and towards the end of 1917 were to be transformed into a new Siemens company with a capital of 25,000,000 roubles, in which the Russian State would take a share.

The third Russian electric company—the Dynamo—in which the English and American Westinghouse companies take a considerable share, doubled its capital in 1917, raising it from 10,000,000 to 20,000,000 roubles. Similarly the Basins of the Donetz Electricity Co., founded in 1916, proposed to build extensive electricity works near the Donetz coal fields, and by utilising the anthracite deposits there furnish Southern Russia with cheap electricity. The company has secured authority to raise its capital from 7 to 14 million roubles. Other new companies are:—The Donetz Electric Power Co., 5,000,000 roubles; Electrification of the Grosny-Naphtha District Co., 4,600,000 roubles; and South Russia Electric Installations Co., 30,000,000 roubles. The two related companies—the Petrograd Electric Lighting Co. and the Baku Electric Power Co.—have also increased their capital from 9 to 13 million roubles. Its internal disorganisation has hindered Russia from undertaking the utilisation of its many waterfalls, although in 1917, 32,000,000 roubles were allocated to deal with the fall on the River Wolchow. As an outcome of the coal deadlock, many new electric railway schemes have been planned, such as the Crimea railway, that of Trans-Caucasia, and the Kars line. All these schemes are hung up owing to the internal state of Russia.

Japan's electrical industry has undergone an enormous expansion during the war. So recently as 1913, Japan was obliged, on account of the undeveloped state of her own industry, to draw upon over-sea countries, principally Germany and England. German exports of merchandise to Japan in 1913 were to the extent of 15,000,000 marks; electric machines, about 45,000,000; cables, 3,000,000; high-tension apparatus, 1,700,000; measuring instruments, 660,000 marks, &c. England exported to Japan in the same year to the value of £286,000 (electrical machines, £188,000). Japan's total imports in 1912 reached 35,000,000 yen, 50 per cent. from Germany and 30 per cent. from England.

Since the war the position has completely changed, and Japan's electrical industry has not only been able to supply its own home wants, but also to intervene in the markets of the world. Before the war, that country's output of electrical machines was between 30,000,000 and 35,000,000 yen; in 1916 it reached a value of 85,000,000 yen. This brilliant showing is owing, first, to huge war exports; and, in the second place, and chiefly, to her possession of ample copper resources available at small cost. This advantage which the Japanese industry enjoys over that of the European industry will subsist after the conclusion of peace, for, on account of the dearth of tonnage, European countries, and especially Germany, will be able to import copper only with the utmost difficulty. Thus in the Far East the European electrical industry can hardly hope to compete with that of Japan.

The Swiss electrical industry has suffered much from the war; this is especially so as regards the wholesale industry. The manufacture of electrical products has had to struggle against enormous difficulties—such as the want of raw materials and labour, and the difficulties of transport. These last have completely paralysed exportation to certain countries, notably to Russia. The influence of the war on Swiss exports of electrotechnical products is clearly shown by the following table:—

Swiss Exports in Thousands of Francs.

	1913.	1914.	1915.	1916.	(Jan.—Sept.) 1917.
Electrical machines ...	20,353	15,578	15,245	22,631	16,618
Control apparatus and measuring instruments	2,307	2,037	2,904	4,304	2,609
Glow lamps	850	577	2,369	4,691	4,465
Accumulators	115	85	818	1,131	390
Telegraph and telephone apparatus	150	107	144	1,120	615
Cables and leads... ...	1,403	974	451	510	428
Lamp carbons	143	184	562	478	151
Sundry apparatus ...	4,996	5,740	2,960	5,877	5,033
	30,357	23,283	25,454	40,742	30,307

It should be noted that if the total of exports is larger for 1916 than for 1913, the number of machines exported is less. One thing that must be said is that the retail industry has grown at the expense of the wholesale. In 1916 one-half of Switzerland's exports of accumulators and batteries went to France; likewise, the whole of the glow lamp exports, which had practically quadrupled, went to France and Italy. Of the Central Powers, Germany held first place as recipient, more especially of electrical machines, owing to their abnormal dearth there, due to that country's inability to furnish itself with copper.

Lastly, the Dutch market has undergone considerable development since the war, as has also that of Spain. The wants of the latter country will be still larger after the war, for the growth of the Spanish industry has been very rapid.

A few words in conclusion as to the future of the electrical industry of the world. We said above that the Americans, who were much interested in the reconstitution of the invaded countries, had estimated the requirements of France in the matter of electrotechnical products at 500,000,000 fr. They estimated, furthermore, those of Belgium at 250,000,000 fr. On these bases the reconstitution of all the invaded lands would demand fully 1,000,000,000 fr. Nothing short of this will be needed to occupy the electrical industry of the world for many years to come. On the other hand, the normal calls for electrical products will greatly increase after the war. The general lack of coal, which will continue long after the war, will everywhere lead to the utilisation to a greater extent than formerly of water-power, &c. Furthermore, the scarcity of foodstuffs, cotton, &c., will give a new spurt to the realisation of irrigation schemes in Italy, Russia, Asia, and other countries, and all such schemes imply huge hydro-electric installations. In lands lacking great water resources, small installations will have to be superseded by big generating stations erected near coal mines. Finally, the fact must not be lost sight of that the extensive electrochemical and electrometallurgical establishments which have grown up during the war will need after the war an enormous amount of electrical energy. Moreover, the call for electric power in all industries will be enlarged to an extraordinary degree after the war; for electricity tends daily to become the basis of industry in all its branches. Its more rational production, enabling energy to be supplied at a much lower rate, will raise it from the position of a mere accessory to that of the very essence of all industrial production.

Electric Railway Furnishes Steam for Industrial Firms.—In addition to supplying electricity to businesses and factories, the Rochester Railway and Light Co., of Rochester, N.Y., is now also giving steam to a number of factories. Two years ago the steam line was extended across the river, but on account of the demand for added heat, it was found necessary to install a new steam feed line. The pipe line which has been constructed is somewhat of a novelty in that it extends about 2,000 ft. without a single joint. It is practically a solid metal pipe line, which, although it came in sections of 20 ft. each originally, has been welded together by the oxy-acetylene process. The method of assembling the parts adopted in this case is a new departure, and eliminates the use of all screw joints and flanges, thereby ensuring the least possible amount of leakeage. It has been found by experiment that the welded part is stronger than any other portion of the line. The new pipe will be covered with heat-insulating materials, and the line has been run across the river by means of the recently-constructed pipe bridge. The line is to be used for industrial purposes, as well as for the heating plants to which it runs.—*Electric Traction.*

REVIEWS.

Aviation Engines. By V. Page. London: Crosby Lockwood and Sons. Pp. xiii+589; figs. 253. Price 15s.

Like many others with long experience in motor-car work, Mr. Page, now a lieutenant in the United States Aviation Corps, has passed on to aeronautical work, and in this present book has written an elementary treatise on petrol engines to which he has added descriptions of existing aviation engines.

The book is well printed, and is provided with a very large number of good line diagrams. It should prove valuable to users of aviation engines, but will not add anything to the designer's knowledge. On practically all things appertaining to engines the author is sound, as is to be expected from the editor of the foremost automobile journal in America; but on aeronautical matters he is sometimes inaccurate. As a point of minor criticism, one regrets the habit that permits the use of different descriptive terms in reference to particular things; for example, although the title is "Aviation Engines," other terms are also used in the text, such as "aerial motors," "aircraft motors," and again, "airplanes" and "aeroplanes" are indifferently employed. The various terms peculiar to America should present no difficulty to the English reader owing to the clear references to the drawings.

Naturally, Chapter VI, which deals with ignition systems and apparatus, and the latter part of Chapter XII, dealing with electric starting, claim first attention. In no other book on engines is the subject treated so fully, ranging from elementary principles to full descriptions of existing types. There are no design formulæ, nor are there any points which are of value to manufacturers of electrical apparatus. On the latter point there is a distinct void in our literature, although two papers with a small amount of such information have been read before technical societies recently. When war broke out practically all our magnetos were imported, the exception being the Thomson-Bennett, and when we started to manufacture, difficulties innumerable cropped up. The three chief difficulties consisted in obtaining (1) a non-bulky insulating covering for the high-tension winding, (2) an effective magnet steel, and (3) an insulating material for the distributor which, in addition to being an effective insulator, had to possess the same rate of wear as the brass segments, and which did not take up a brassy face under the continuous rubbing of the rotating distributing brush. These difficulties have now been overcome, and research and experimental work have resulted in further advances in design, and evolution of new types, of which the Dixie, described at page 184, is one form. Judging from the statements at pp. 569 and 570 on electric starting and battery ignition, America is far behind England, but it would be inexpedient to discuss this further. Attention may be drawn at this stage to the very clear diagram of the ignition system of the Gnome engine at fig. 208.

The opening chapter considers the requirements of aviation engines, but it is so much amiable matter, and should not be read seriously. The description of the three classes of dirigibles on page 18 is utterly misleading, and the statement at p. 21 that "The airplane is supported by air reaction *under* the planes or lifting surfaces" shows how little real knowledge the author has of aeronautics. Chapter II deals with the principles of two- and four-stroke engines, which are clearly defined. The development of the two-stroke engine is not given a fair share of attention, and the conclusion that for large powers it cannot compete with the four-stroke should not be accepted.

In Chapter III the efficiency of petrol engines is comprehensively considered, and in Chapter IV is described the method of working of petrol engines, together with a general account of the various kinds of multi-cylinder engines.

Chapter V deals with fuels and carburettors, and Chapter VII covers lubricating systems, and air and water-cooling systems. These two chapters are very clearly written, and illustrated by excellent diagrams.

Chapter VIII. Cylinder construction, valves and valve arrangement, and valve timing are dealt with at length in an illuminating manner; the reader should note, however, that in addition to the advantages of the offset crankshaft set out at page 243, such an engine has a less overall height and weight than an ordinary engine, and allows a valve setting which results in a greater volumetric efficiency.

In Chapter IX are described pistons, connecting rods, cam and crankshafts, and crank cases. Chapter X deals with complete power plants and their installation in aeroplanes. This is a very comprehensive chapter, and, together with the specific descriptions of American engines given in Chapter XII, covers the whole field of aeronautical engines. The latter part of Chapter X deals very well with defects and troubles, and the locating and remedying thereof.

Chapter XI gives the processes of dismantling and reassembling engines, and the tools to be used in these operations, which are described at length, and again one must comment favourably on the clearness and large number of illustrating diagrams.—W. E. Dommett.

The Electron: Its Isolation and Measurement and the Determination of some of its Properties. By Prof. R. A. Millikan. Pp. xii+268. Chicago: The University Press. Price $1.50.

This book, by the well-known Professor of Physics of the University of Chicago, is one of the Science Series established by the trustees of the university—a series which has owed its origin "to a feeling that there should be a medium of publication occupying a position between the technical journals with their short articles and the elaborate treatises which attempt to cover several or all aspects of a wide field." This particular volume is of great interest, as it details in a thorough manner the work done on the electron right up to 1916. Passing over the first few chapters, which have to do with the various aspects of early views of electricity and conduction in gases, we come to an account of first attempts at the direct determination of e. Townsend's work is described, then Sir J. J. Thomson's, Wilson's, and finally the author's. Up to 1906 the result obtained for e had been quite variable, and no reliance could be placed on any one figure; and in view of the extreme importance of an exact and reliable determination, the author spent much time in research work upon this question. His account of his early experiments is extremely interesting. Those who have been engaged upon original work of the same or a similar kind will recognise its difficulty, and the care that has to be taken to allow for all the factors concerned—such a small thing, for instance, as an infinitesimal amount of evaporation from a water droplet may affect a result out of all seeming proportion to the cause. The later and exact determination of e was one of the triumphs of physics, and the author describes in Chapter V how this was accomplished. He first deals with the failure of Stokes's Law, which is concerned with the rate of fall of a spherical drop under gravity, and the corrections that have to be applied to the law due to want of homogeneity in the medium, and he then goes on to describe experimental work undertaken on this basis. The final result was $e = 4{\cdot}774 \times 10^{-10}$ electrostatic units.

Even then Prof. Millikan was not satisfied, and he spent the better part of another two years on further experiment with new apparatus and with a completely new determination of all the factors involved; but the result thus obtained in 1916 came out to the fourth place exactly the same as the value published in 1913 stated above.

Prof. Millikan is a bit of a humorist, and sometimes supplies a touch of lightness to what otherwise would be fairly concentrated reading. Thus: "Perhaps these numbers (referring to e and N) have little significance to the general reader who is familiar with no electrical units save those in which his monthly light bills are rendered. If these latter seem excessive it may be cheering to reflect that the number of electrons contained in the quantity of electricity which courses every second through a common sixteen candle-power electric lamp filament and for which we pay one hundred thousandth of one cent, is so large that if all the two and one-half million inhabitants of Chicago were to begin to count out these electrons and were to keep on counting them out each at the rate of two a second, and if no one of them were ever to stop to eat, sleep, or die, it would take them just 20,000 years to finish the task."

An important section is that dealing with the evidence for the existence of a sub-electron. It is conceivable that there are electric charges smaller than the electron, and a certain amount of experimental work has even been done which seemed to point to this conclusion. The author, however, after a review of this and careful analysis of his own work thinks the evidence so far adduced is not satisfactory.

The reader will perhaps find Chapter IX, on the structure of the atom, the most interesting and suggestive in the book. There are some good photographs of α-particles and β-particles shooting through air, and of the tracks of β-particles ejected by X-rays from molecules of air. A study of these teaches one something of the relative sizes of atoms and electrons. For instance, "the α-particle being an atom of helium eight thousand times more massive than a negative electron, could no more be deflected by one of the latter in an atom through which it passes than a cannon ball could be deflected by a pea. Yet the figures show that toward the end of its path the α-particle does in general suffer several sudden deflections. Such deflections could be produced only by a very powerful centre of force within the atom whose mass is at least comparable with the mass of the helium atom." Such results as this strongly support the theory that the atom consists of a heavy positively charged nucleus about which are grouped a sufficient number of electrons to render the whole atom neutral.

Says the author, "The notion that an atom can appropriate to itself all the space within its boundaries to the exclusion of all others is then altogether exploded by these experiments. A particular atom can certainly occupy the same space at the same time as any other atom if it is only endowed with sufficient kinetic energy. Such energies as correspond to the motions of thermal agitation of molecules are not, however, sufficient to enable one atom to penetrate the boundaries of another, hence the seeming impenetrability of atoms in ordinary experiments in mechanics."

This work is one of the most suggestive appearing in recent years, and every student of this branch of physics should have it on his bookshelves.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AUSTRALIA.—Full particulars regarding the new invoice requirements of the Commonwealth Government have been published in the *Board of Trade Journal*, including the full text of the combined form of declaration of value and certificate of origin. A concession has been made regarding the basis of valuation for duty purposes. During the period of the war, and for six months afterwards, the basis for duty is to be the home consumption value of the imported goods at the date of the invoice relating to them, instead of at the date of their export to Australia, as was formerly the case. A separate column is to be included in the invoice, showing the actual price at the date of the declaration of equal quantities of identically similar goods to any purchaser for home consumption in this country. The column should be headed: "Domestic value f.o.b. port of export (or factory) at date of invoice, subject to ..... per cent. discount for cash, including (or excluding) cost of outside casing." In the case of goods which are not identically similar to any sold in the domestic trade, the special column referred to must show prices which would be required if selling for home consumption. Such prices should return a percentage of profit on the cost of production and marketing equal to that received in the domestic trade in similar lines.

ARGENTINA.—By a recent Ministerial Resolution, when goods in transit through Argentina are handed over from the Custom House to the railway company for transport to the country of destination, and such transport is effected under the responsibility of the carriers, without the intervention of the owners of the goods, the bonds (for the due arrival of the goods in the country of destination) otherwise required from the interested parties under the Argentine Transit Regulations are to be dispensed with.

ECUADOR.—A number of amendments have recently been made in the Tariff Law of the Republic, which took effect on January 1st. Electrical goods are not specifically affected, but the following provisions of the amending law are of interest:—

A warehousing charge of 6 centavos per cubic foot will be levied on packages in Customs premises for every month, or fraction thereof, up to the date when request for clearance is presented. For each 50 kilogs. of lead, iron, and other metals the charge will be 15 centavos. A discount of 50 per cent. is accorded to importers who clear their goods within 15 days after their arrival; goods not cleared within two months are subject to a surcharge of 25 per cent., which is increased to 50 per cent. if the goods are not cleared within three months.

NEW ZEALAND.—Information has been received at the Department of Overseas Trade to the effect that the New Zealand Government has issued the following notification modifying the basis to be adopted in future in levying import duties on goods assessable at an *ad valorem* rate:—

"Claims are not to be made against importers for increased duty on account of rise in price of merchandise as between the date of invoicing or order and the date of shipment where it is satisfactorily shown that the invoice price is the genuine purchase price as between a buyer in New Zealand and an exporter. This does not apply to house-to-house invoices or to cases where there is no real purchase as ordinarily understood."

It is understood that this has been adopted *as a temporary measure only*, owing to the price fluctuations which occur under present abnormal conditions.

TONGAN ISLANDS.—Under the Customs and Tariff Act, 1917, the import duty leviable upon dutiable articles unspecified in the Tariff (including electrical goods) has been increased from 10 per cent. *ad val.* to 12½ per cent. *ad val.*

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

12,306. "Non-accumulative electric signalling indicator for colliery shafts, &c." H. Brown & J. H. Evans. July 29th.

12,313. "Control of dynamo-electric machinery." J. C. Wilson. July 29th.

12,315. "Electro-magnetic speed-changing gear." Menco-Elma Syndicate. July 29th. (U.S.A., September 22nd, 1917.)

12,322. "Electro-pneumatic braking systems." British Thomson-Houston Co. (General Electric Co., U.S.A.) July 29th.

12,327. "Friction drive for electric switchgear." E. N. Bray. July 29th.

12,353. "Electric lampholders." J. Blaymires. July 30th.

12,367. "Electric time transmitter or master clock." J. J. Liverton. July 30th.

12,369. "Sparking plugs for internal-combustion engines." J. K. White. July 30th.

12,382. "Electric signalling lamps." O. Lucas. July 30th

12,413. "Electrically-locating submarines." W. H. Bragg & H. L. Callendar. July 30th.

12,414. "Devices of the vibrated-diaphragm type for giving audible signals." J. F. Monnot. July 30th.

12,443. "Actuating signals on, and communicating with, trains." H. A. Thompson. July 31st.

12,449. "Sparking plugs for internal-combustion engines." W. A. Hopkins & F. Turner. August 1st.

12,470. "Control of dynamo-electric machinery." J. C. Wilson. July 31st.

12,477. "Direct-current starting switches for electric motors." J. S. Macintosh. July 31st.

12,480. "Ignition sparking plugs for internal-combustion engines." F. L. Rapson. July 31st.

12,486. "Spark plugs." E. O'Connell. July 31st.

12,487. "Electric cells." E. H. Exley & H. Leitner. July 31st.

12,488. "Operating electric switches from a distance." A. H. Francks, and Telephos Domestic & Street Lighting Co. August 1st.

12,490. "Electric internal tube heaters." H. Gutzwiller. July 31st. (Switzerland, August 8th, 1917.)

12,507. "Electric speed governor." T. N. C. Koressios. July 31st.

12,510. "Valves for generating electric oscillations, amplifying electric currents, or rectifying same." A. G. Bloxham (Russische Akt. Ges. L. M. Ericsson & Co.). July 31st.

12,545. "Instantaneously varying photo-electric resistance." F. Tavani. August 1st.

12,551. "Sparking plugs for internal-combustion engines." J. E. Barrows. August 1st.

12,554. "Telephone exchange systems." Western Electric Co. (Western Electric Co., U.S.A.) August 1st.

12,555.—"Electric hand lamp." Accumulator Service, S. T. Jolley and A. H. Knight. August 1st.

12,567. "Electrolytic apparatus." E. O. Benjamin. August 1st. (U.S.A., August 1st, 1917.)

12,593. "Constant-current dynamos." S. Smith & Sons, V. A. Trier, and Trier & Martin. August 1st.

12,600. "Electric terminal connectors, &c." C. E. Tinson. August 1st.

12,601. "Electric connectors, &c." C. E. Tinson. August 1st.

12,642. "Feeding polyphase-current circuits with monophase current." T. Buess & H. Gutzwiller. August 2nd. (Switzerland, August 6th, 1917.)

12,643. "Electric heating elements, and means of conveying heat therefrom." J. A. Colquhoun. August 2nd.

12,650. "Means for preventing rapid exhaustion of armiary batteries." T. McLrod. August 2nd.

12,653. "Secondary electric batteries or accumulators." W. E. Spencer and Tudor Accumulator Co. August 2nd.

12,656. "Electrical transmission applicable to radio-telegraphy and telephony, &c." L. Levy. August 2nd. (France, August 4th, 1917.)

12,659. "Apparatus for controlling electric circuits." J. Palin. August 2nd.

12,661/2. "Carbons for electric arc lamps." H. B. Grylls & W. Heape. August 2nd.

12,664. "Electric generators and motors." L. Collette. August 2nd.

12,668. "Electric machine operating as motor or dynamo." A. Tricoche. August 2nd.

12,669. "Constant-current dynamos." S. Smith & Sons, V. A. Trier, and Trier & Martin. August 2nd.

12,670. "Centre-rail electric traction." G. N. Fell. August 2nd.

12,672. "Construction for electric dynamos and motors for aircraft, &c." L. Murphy. August 2nd.

12,707/8. "Ignition systems for internal-combustion engines." A. H. Midgley and C. A. Vandervell & Co. August 3rd.

12,709. "Electric heating apparatus." I. Sordi. August 3rd.

12,711. "Production of ammonia gas or ammonia hydrate by electro-decomposition of water and atmospheric air." J. T. Dixon & J. Harvey. August 3rd.

12,717. "Quick-break switch." W. J. King. August 3rd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

6,805. Electrical switches for motor-cars and other purposes. R. H. Rogers and S. Smith & Sons. May 12th, 1917. (Cognate application, 15,688/17.) (117,279.)

7,943. Wireless signalling systems. British Thomson-Houston Co. (General Electric Co., U.S.A.) June 2nd, 1917. (117,283.)

8,100. X-ray apparatus. British Thomson-Houston Co. General Electric Co.) June 6th, 1917. (117,284.)

8,147. Electrical appliance for the inspection of the interior of casks, jars, or other vessels or chambers. W. Downs & J. M. Fitt. June 7th, 1917. (117,285.)

9,960. Electric Motors. T. L. R. Cooper. July 10th, 1917. (Addition to 17,292/16.) (117,296.)

10,033. Control of electrically-operated switches. A. West & Co. and W. L. Wise. July 11th, 1917. (117,298.)

10,073. Method of refining metallic zinc-bearing materials by the electrolytic process. Electrolytic Zinc Co. July 26th, 1916. (108,312.)

11,287. Electrical couplings or connections. K. E. I. Guinness. August 4th, 1917. (117,325.)

11,983. Electric transforming and converting apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.) August 21st, 1917. (117,330.)

12,125. Ignition apparatus for internal-combustion engines. A. E. White (Remy Electric Co.). August 23rd, 1917. (117,332.)

12,479. Phase converters for polyphase distributing systems. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric and Manufacturing Co., U.S.A.) August 30th, 1917. (117,336.)

12,731. Interrupters for electric circuits. H. W. F. Ireland. September 5th, 1917. (117,339.)

15,069. Sparking plugs for internal-combustion engines. L. S. Clarke October 17th, 1917. (Cognate application, 2,095/18.) (117,362.)

17,080. Lighting devices for motor vehicles. Benjamin Electric, Ltd. November 27th, 1916. (111,669.)

18,901. Telephone receivers. Soc. Francaise Radio-Electrique. December 7th, 1916. (Addition to 100,281.) (112,433.)

1918.

3,617. Starting switches for electric motors. W. P. Thompson (Officine Elettro-Meccaniche). March 1st, 1918. (117,418.)

8,290. Electro-magnetically-controlled signal reverser for use on railways. Sykes Interlocking Signal Co., W. R. & R. W. Tarrest. May 17th, 1918. (117,435.)